EVINRUDE®
E-TEC®

Service Manual

Evinrude E-TEC G2

115 H.O., 140 HP, 150 HP(1.865L Inline 3–Cylinder)

5010836

Version A

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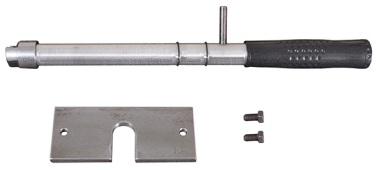

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Ultra Lock (red)
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Reference Information

1

Safety Notice

Before working on any part of the outboard, read the SAFETY section at the end of this manual.

This publication is written for qualified, factory-trained technicians who are already familiar with the use of *Evinrude* Special Tools. The included information is not a substitute for work experience. It is an organized guide for reference, repair, and/or maintenance.

The following symbols and/or signal words may be used in this document.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

NOTICE

Indicates an instruction which, if not followed, could severely damage engine components or other property.

These safety alert symbols mean:

ATTENTION!

BECOME ALERT!

YOUR SAFETY IS INVOLVED!

IMPORTANT: Identifies information that controls correct assembly and operation of the product.

ENVIRONMENTAL NOTE

A note which provides tips and behaviors related to protecting the environment.

DO NOT perform any work until you have read and understood these instructions completely.

Strictly adhere to torque wrench tightening specifications.

Should removal of any locking fastener (lock tabs, locknuts, or patch screws) be required, always replace with a new one.

When replacement parts are required, use *Evinrude Genuine Parts* or parts with equivalent characteristics, including type, strength and material. Use of substandard parts could result in injury or product malfunction.

Always wear EYE PROTECTION AND APPROPRIATE GLOVES when using power tools.

Unless otherwise specified, engine must be OFF when performing this work.

Always be aware of parts that can move, such as flywheels, propellers, etc.

Some components may be HOT. Always wait for engine to cool down before performing work.

If you use procedures or service tools that are not recommended in this manual, YOU ALONE must decide if your actions might injure people or damage the outboard.

This document may be translated into other languages. In the event of any discrepancy, the English version shall prevail.

⚠ DANGER

Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off. Remove propeller before servicing and when running the outboard on a flushing device.
DO NOT run the engine indoors or without adequate ventilation or permit exhaust fumes to accumulate in confined areas. Engine exhaust contains carbon monoxide which, if inhaled, can cause serious brain damage or death.

⚠ WARNING

Wear safety glasses to avoid personal injury, and set compressed air to less than 25 psi (172 kPa).
The motor cover and flywheel cover are machinery guards. Use caution when conducting tests on running outboards. DO NOT wear jewelry or loose clothing. Keep hair, hands, and clothing away from rotating parts.
During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboard's weight with a suitable hoist or the tilt support bracket during service.
To prevent accidental starting while servicing, disconnect the battery cables at the battery. Twist and remove all spark plug leads.
The electrical system presents a serious shock hazard. DO NOT handle primary or secondary ignition components while outboard is running or flywheel is turning.
Gasoline is extremely flammable and highly explosive under certain conditions. Use caution when working on any part of the fuel system.
Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.
Do not smoke, or allow open flames or sparks, or use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.
Keep all electrical connections clean, tight, and insulated to prevent shorting or arcing and causing an explosion.
Always work in a well ventilated area.
Replace any locking fastener (locknut or patch screw) if its locking feature becomes weak. Definite resistance to tightening must be felt when reusing a locking fastener. If replacement is indicated, use only authorized replacement or equivalent.

Abbreviations Used In This Manual

Units of Measurement

A	Amperes
amp-hr	Ampere hour
fl. oz.	fluid ounce
ft. lbs.	foot pounds
HP	horsepower
in.	inch
in. Hg	inches of mercury
in. lbs.	inch pounds
kPa	kilopascals
ml	milliliter
mm	millimeter
N·m	Newton meter
P/N	part number
psi	pounds per square inch
RPM	revolutions per minute
°C	degrees Celsius
°F	degrees Fahrenheit
ms	milliseconds
µs	microseconds
Ω	Ohms
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current

List of Abbreviations

ABYC	American Boat and Yacht Council
ATDC	After Top Dead Center
AT	Air Temperature Sensor
BPS	Barometric Pressure Sensor
BTDC	Before Top Dead Center
CAN	Controller Area Network
CCA	Cold Cranking Amps
CFR	Code of Federal Regulations
CPS	Crankshaft Position Sensor
DPS	Dynamic Power Steering
ETB	Electronic Throttle Body
ETC	Electronic Throttle Controller
EGT	Exhaust Gas Temperature
EMM	Engine Management Module
EPA	Environmental Protection Agency
ESC	Electronic Shift Controller
FNR	Forward, Neutral, Reverse
FWD	Forward
HPS	Helm Pressure Sensor
ICOMIA	International Council of Marine Industry Associations
ID	Inside Dimension
LED	Light Emitting Diode
MCA	Marine Cranking Amps
MWS	Modular Wiring System
NMEA	National Marine Electronics Assoc.
OOC	Out Of Correlation
PBLC	Public (*NMEA 2000*) Network
PPS	Pump Pressure Sensor
PRVT	Private (Remote Control) Network
PTPS	Port Steering Pressure Sensor
REV	Reverse
ROM	Read Only Memory
S.A.F.E.	Speed Adjusting Failsafe Electronics
SAC	Start Assist Circuit
SAE	Society Of Automotive Engineers
SPS	Shift Position Sensor
STPS	Starboard Steering Pressure Sensor
STS	Steering Position Sensor
SYNC	Synchronization
TDC	Top Dead Center
TPS	Throttle Position Sensor
USCG	United States Coast Guard
WOT	Wide Open Throttle
WTS	Water Temperature Sensor

Standard Torque Specifications

Size	In. Lbs	Ft. Lbs	N·m
No. 6	7–10	0.58–0.83	0.8–1.1
No. 8	15–22	1.25–1.83	1.7–2.5
No. 10	24–36	2–3	2.7–4.0
No. 12	36–48	3–4	4.0–5.4
1/4 in.	60–84	5–7	7–9.5
5/16 in.	120–144	10–12	13.5–16.5
3/8 in.	216–240	18–20	24.5–27
7/16 in.	336–384	28–32	38–43.5
M3	15–22	1.25–1.83	1.7–2.5
M4	24–35	2–2.9	2.7–4.0
M5	35–60	2.9–5	4.0–6.8
M6	84–106	7–8.8	9.5–12
M8	177–204	14.7–17	20–23
M10	310–336	25.8–28	35–38

IMPORTANT: These values apply only when a specific torque for a specific fastener is not listed in the appropriate section. When tightening two or more screws on the same part, DO NOT tighten screws completely, one at a time.

⚠ WARNING

Torque wrench tightening specifications must be strictly adhered to. Replace any locking fastener (locknut or patch screw) if its locking feature becomes weak. Definite resistance to turning must be felt when reusing a locking fastener. If replacement is specified or required because the locking fastener has become weak, use only authorized *Evinrude Genuine Parts*.

Product Reference and Illustrations

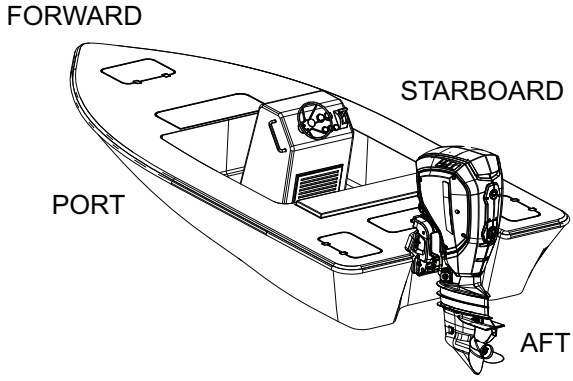
BRP US Inc. reserves the right to make changes at any time, without notice, in specifications and models and also to discontinue models. The right is also reserved to change any specifications or parts, at any time, without incurring any obligation to equip same on models manufactured prior to date of such change. Specifications used are based on the latest product information available at the time of publication.

The continuing accuracy of this manual cannot be guaranteed.

All photographs and illustrations used in this manual may not depict actual models or equipment, but are intended as representative views for reference only.

Certain features or systems discussed in this manual might not be found on all models in all marketing areas.

All service technicians must be familiar with nautical orientation. This manual often identifies parts and procedures using these terms.



NAUTICAL ORIENTATION

1

Engine Identification

MODEL NUMBER*: **K 115 HWLF AF D**

ENGINE FAMILY IDENTIFICATION:

- **A** Alternate Feature**
- **C** 66° V6 Models
- **E** 74° V6 Models***
- **H** 74° V6 Models****
- **K** Inline 3-Cylinder Models

HORSEPOWER

DESIGN FEATURES:

- **A** *Evinrude iDock* System
- **C** Counter Rotation
- **F** Dynamic Power Steering (DPS)
- **G** Gray
- **H** High Output (H.O.)
- **I** *i-Dock* Compatible Steering (original *i-Dock / SeaStar Optimus* System)
- **J** Jet Drive
- **K** 2–Star Emisisons
- **O** Integrated Hydraulic Steering (IHS, also used with original *i-Dock/SeaStar Optimus*)
- **P** Cable or External Hydraulic Steering
- **U** 3–Star Emissions
- **W** White

SHAFT LENGTH:

- **L** 20 in. (508 mm)
- **X** 25 in. (635 mm)
- **Z** 30 in. (762 mm)

MODEL IDENTIFICATION

The first two characters identify **Model Version:**

- **AA** A First major variant
- **AB** A Second major variant
- **AF** A Third major variant

- follow the model identification shown above.
- subsequent versions continue through the alphabet as AG, AH etc.
- will not use letters from the word INTRODUCES to identify model version.

The third character identifies **Model Revision:**

- AA **A** First revision
- AA **B** Second revision
- AA **C** Third revision

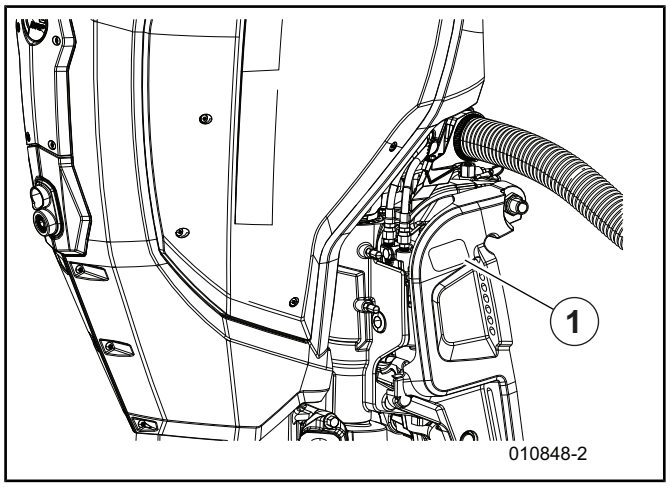
Subsequent revisions continue through the alphabet in order (*A through Z).*

* Order of Precedence: Family, HP, HO, Color, Shaft Length, Rotation, Steering Type, Version/Revision
** Refer to **Model Tables** in the correct **Service Manual**.
***ABA through AGG models.
****AGH and newer models.

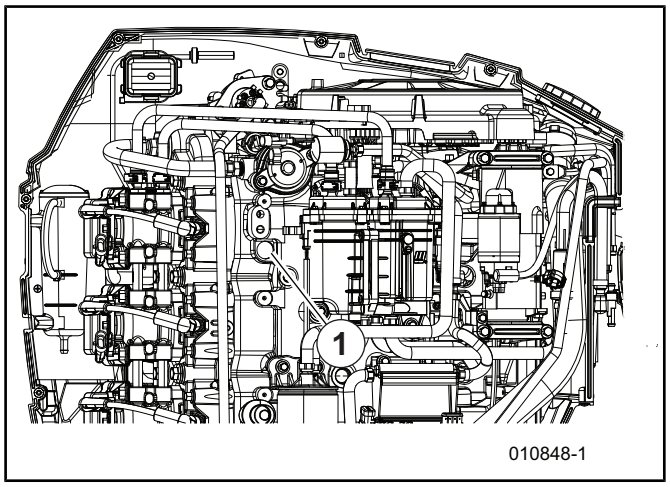
April 2019

G2ModelDesignationTable_RevCROWEps-3A298AC7

Model and serial numbers are located on the swivel bracket and on the powerhead.



1. Serial number/model number label



1. Serial number

Models Covered

This service manual covers information on the following *Evinrude E-TEC G2*, Inline 3–Cylinder, models, starting with serial number tbd.

Engine Type: Inline 3-Cylinder, **Displacement:** 113.8 cu. in. (1.865 L) **Charging System:** 30 Amp Regulated, **Gearcase:** SLX2-Type, **Gear Ratio:** 13:27, (0.48), (2.08:1)								
HP	**Model Number**	**Software Version**	**Shaft Length**	**Base Color**	**Midsection & Steering**	**Rotation**	**Standard Features**	**Special Features**
115	K115HGLFAAA	3030575	20 in.	Gray	DPS[2]	Standard	Digital EST[3]	H.O.
	K115HWLFAAA		20 in.	White	DPS[2]	Standard	Digital EST[3]	H.O.
	K115HGLPAAA		20 in.	Gray	Non–DPS[1]	Standard	Digital EST[3]	H.O.
	K115HWLPAAA		20 in.	White	Non–DPS[1]	Standard	Digital EST[3]	H.O.
	K115HGXFAAA		25 in.	Gray	DPS[2]	Standard	Digital EST[3]	H.O.
	K115HWXFAAA		25 in.	White	DPS[2]	Standard	Digital EST[3]	H.O.
	K115HGXPAAA		25 in.	Gray	Non–DPS[1]	Standard	Digital EST[3]	H.O.
	K115HWXPAAA		25 in.	White	Non–DPS[1]	Standard	Digital EST[3]	H.O.
	K115HGXCAAA		25 in.	Gray	Non–DPS[1]	Counter	Digital EST[3]	H.O.
	K115HWXCAAA		25 in.	White	Non–DPS[1]	Counter	Digital EST[3]	H.O.
140	K140GLFAAA	3030600	20 in.	Gray	DPS[2]	Standard	Digital EST[3]	–
	K140WLFAAA		20 in.	White	DPS[2]	Standard	Digital EST[3]	–
	K140GLPAAA		20 in.	Gray	Non–DPS[1]	Standard	Digital EST[3]	–
	K140WLPAAA		20 in.	White	Non–DPS[1]	Standard	Digital EST[3]	–
	K140GXFAAA		25 in.	Gray	DPS[2]	Standard	Digital EST[3]	–
	K140WXFAAA		25 in.	White	DPS[2]	Standard	Digital EST[3]	–
	K140GXPAAA		25 in.	Gray	Non–DPS[1]	Standard	Digital EST[3]	–
	K140WXPAAA		25 in.	White	Non–DPS[1]	Standard	Digital EST[3]	–
	K140GXCPAAA		25 in.	Gray	Non–DPS[1]	Counter	Digital EST[3]	–
	K140WXCPAAA		25 in.	White	Non–DPS[1]	Counter	Digital EST[3]	–

[1] Non-DPS Steering, use with cable or external hydraulic steering [2] Full Featured with Dynamic Power Steering
[3] Digital Electronic Shift & Throttle

Engine Emissions Information

Failing to follow these instructions when installing a certified engine in a vessel violates federal law (40 CFR 1068.105 (b)), subject to fines or other penalties as described in the Clean Air Act.

A repair shop or person of the owner's choosing may maintain, replace, or repair emission control devices and systems. These instructions do not require components or service by BRP or authorized *Evinrude* dealers. Although an authorized *Evinrude* dealer has the in-depth technical knowledge and tools to service *Evinrude* outboard engines, the emission-related warranty is not conditioned on the use of an authorized *Evinrude* dealer or any other establishment with which BRP has a commercial relationship.

For emission-related warranty claims, BRP is limiting the diagnosis and repair of emission-related parts to authorized *Evinrude* dealers. For more information, please refer to the US EPA EMISSION-RELATED WARRANTY contained herein. Proper maintenance is the owner's responsibility. A warranty claim may be denied if, among other things, the owner or operator caused the problem through improper maintenance or use.

You must follow the instructions for fuel requirements in the **Fuel Requirements** section of this manual. Even if gasoline containing greater than ten volume percent ethanol is readily available, the US EPA has issued a prohibition against the use of gasoline containing greater than 10 vol% ethanol that applies to this engine. The use of gasoline containing greater than 10 vol% ethanol with this engine may harm the emission control system.

Manufacturer's Responsibility

Beginning with 1999 model year outboards, manufacturers of marine engines must determine the exhaust emission levels for each engine horsepower family and certify these outboards with the United States of America Environmental Protection Agency (EPA). An emissions control information label, showing emission levels and engine specifications, must be placed on each outboard at the time of manufacture.

Dealer's Responsibility

When performing service on all 1999 and more recent *Evinrude* outboards that carry an emissions control information label, adjustments must be kept within published factory specifications.

Replacement or repair of any emission related component must be executed in a manner that maintains emission levels within the prescribed certification standards.

Dealers are not to modify the outboard in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

Exceptions include manufacturer's prescribed changes, such as altitude adjustments, for example.

Owner Responsibility

The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.

The owner/operator is not to, and should not allow anyone to, modify the engine in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

Tampering with the fuel system to change horsepower or modify emission levels beyond factory settings or specifications will void the product warranty.

EPA Emission Regulations

All new 1999 and more recent *Evinrude* outboards manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new watercraft marine spark ignition engines. This certification is contingent on certain adjustments being set to factory

standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design. The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions for marine products. For more detailed information on this subject, you may contact the following locations:

U.S. Environmental Protection Agency
Office of Transportation and Air Quality
Certification Division
Gasoline Engine Compliance Center
2000 Traverwood Drive
Ann Arbor, MI 48105

EPA Internet Website:

www.epa.gov/otaq

Service Specifications

HP		115 H.O.	140	
Engine				
Full throttle operating range		5000–6000 RPM	5000–6000 RPM	
Power		115 HP (84.6 kw) @ 5500 RPM	140 HP (100.8 kw) @ 5500 RPM	
Idle RPM in NEUTRAL		400 ± 50 RPM		
Idle RPM in Gear		500 ± 50 RPM		
Weight (may vary depending on model)		Non-Power Steering 20 in. (L) Models 378 lbs. (171 kg) Non-Power Steering 25 in. (X) Models 386 lbs. (175 kg) Power Steering 20 in. (L) Models 390 lbs. (177 kg) Power Steering 25 in. (X) Models 398 lbs. (181 kg)		
Engine Type		Inline 3–Cylinder Loop-Charged		
Displacement		113.8 cu. in. (1.865 L, 1865 cm^3)		
Bore		3.854 in. (97.89 mm)		
Stroke		3.249 in. (82.55 mm)		
Standard Bore		3.3853 to 3.3868 in. (85.987 to 86.025 mm) To bore oversize, add piston oversize dimension to standard bore		
Top Crankshaft Journal		2.18775 to 2.188 in. (55.56 to 55.57 mm)		
Center Crankshaft Journals		2.188 to 2.1885 in. (55.57 to 55.58 mm)		
Bottom Crankshaft Journal		1.5747 to 1.5752 in. (40.0 to 40.01 mm)		
Rod Crankpin		1.4995 to 1.5000 in. (38.09 to 38.106 mm)		
Piston Ring End Gap, Both		0.022 to 0.028 in. (0.57 to 0.72 mm)		
Cooling System				
Thermostat		143°F (62°C)		
Maximum Temperature		203°F (95°C)		
Water Pressure	Idle	1.7 to 5 psi (11.7 to 34.4 kPa)		
	@5000 RPM	24 to 40 psi (165 to 276 kPa)		
Pressure Relief Valve (open)		28 psi to 30 psi (193 to 206 kPa) (approximate)		

HP		115 H.O.	140	
Fuel / Oil System				
Fuel/Oil Ratio		*EMM* Controlled		
Starting Enrichment		*EMM* Controlled		
Preferred Fuel		Regular unleaded gasoline		
Acceptable Fuel		Use unleaded regular gasoline. The use of unleaded gasoline containing alcohol above the percentage specified by government regulations is not recommended. Do NOT use Fuel labeled "E85." Use of fuel labeled E15 is prohibited by U.S. EPA Regulations.		
Minimum Octane		87 AKI (R+M)/2 or 90 RON		
Fuel Pressure (minimum)	Lift Pump	7 psi (48 kPa) @ idle		
	High Pressure Pump	30 to 42 psi (287 to 289 kPa) @ 5500 RPM		
Maximum Fuel Inlet Vacuum		4 in. Hg. (13.5 kPa)		
Fuel Filters	Inline	P/N 360941		
	Water Separating	P/N 5009676		
Fuel Additives		2+4 Fuel Conditioner, Fuel System Cleaner. Use of other additives may result in engine damage.		
Lubricant	Preferred	*XPS Marine XD100*		
	Acceptable	*XPS Marine XD50,* Synthetic *NMMA® TC-W3® Certified Oil*		
Capacity	On-Engine Tank Only	1.88 Gallons (7.12 liters)		
	With Remote Oil Tank			
Electrical System				
Minimum Battery Requirements		675 CCA (845 MCA); or 750 CCA (940 MCA) below 32°F (0°C) (Use a 107 amp-hr battery for extreme applications.)		
Alternator		30 Amp with Voltage Regulator. Refer to Pre-delivery and Installation Guide for multiple battery applications.		
Analog Tachometer Setting		6 pulse (12 pole)		
Charging Isolator		Integral, Terminal on Engine Harness		
Engine Fuses		3 Amp MINIFUSE, P/N 3011805, 5 Amp MINIFUSE, P/N 514764 10 Amp MINIFUSE, P/N 514766, 30 Amp MINIFUSE, P/N 3011729		
Engine Relays	Starter	12V 35A SPDT, P/N 3011790		
	B+ to 55 V System	12V 35A SPDT, P/N 3011790		

HP		115 H.O.	140	
Ignition System				
Type		Inductive Discharge		
Firing Order		1 – 2 – 3		
Ignition Features		*EMM* Controlled		
RPM Limit (in gear)		6250 RPM		
Crankshaft Position Sensor Air Gap		Fixed		
Spark Plug		Champion† **Q C 1 0 W E P I A** @ 0.028 ± 0.003 in. (0.71 mm)		
Gearcase				
Gear Ratio		"SLX-2" Type Gearcase: 13:27 (0.48) (2.08:1)		
Lubricant		HPF Pro Gearcase Lubricant		
Capacity	Standard Rotation	Gearcase only – 26.9 fl. oz. (795 ml) Gearcase, vent hose and oil reservoir 32.8 fl. oz. (969 ml)		
	Counter Rotation			
Shift Rod Height		Refer to **Shift Rod Adjustment**		
Trim and Tilt System				
Lubrication		Power Trim/Tilt Fluid, P/N 767969		
Fluid Capacity		21 fl. oz. (610 ml)		
Trim Range		0° to 21° (-6° to 15°)		
Tilt Range		22° to 75° (16° to 69°)		
Steering System				
Hydraulic Steering Fluid		SeaStar Hydraulic fluid, P/N 770891 or Hydraulic fluid meeting MIL SPEC: Mil-H-5606		
Fluid Capacity (NOT including helm or hydraulic hoses)		10 oz. (300 ml) (approximate)		
Steering Range (lock to lock)		–32° to +32°, 64° Total (see engine Profile Drawing)		

Notes

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

Routine Service

Inspection and Maintenance Schedule

Routine inspection and maintenance is necessary to prolong outboard life. The following chart provides guidelines for inspection and maintenance to be performed by an authorized Dealer.

IMPORTANT: Outboards used in rental, commercial, or other high hour applications require more frequent inspections and maintenance. Adjust schedule for operating and environmental conditions.

Description of Service	Every 500 Hours(1)		
	Routine Inspection		
	Engine Care Products		
Anodes (anti–corrosion), check condition		X	X
Back pressure probe, replace			X
Batteries, check connections and condition		X	X
Cooling system; check water pump indicator / water pressure		X	X
Displays and gauges, self-test/warning horn, check operation		X	X
Emergency cut–off switch(es) and tether cord, check operation		X	X
Engine to transom mounting hardware, re-tighten (40 ft. lbs.)			X
Fuel and oil systems, inspect and repair leaks(2)		X	X
Fuel filters, replace			X
Gearcase and water inlet screens, check condition		X	X
Gearcase lubricant, inspect level	A	X	
Gearcase lubricant, replace	A		X
Grease fittings, lubricate(3)	C		X
Oil filter, replace			X
Power trim and tilt system, check operation	B		X
Propeller, check condition		X	X
Propeller shaft splines, inspect and lubricate(3)	C		X
Remote control system and switches (START/STOP, Trim etc.) check operation			
Fault codes, access *EMM* information, resolve any fault codes			X
Spark plugs, replace(2)			X
Steering system, inspect fluid level, check hydraulic hose condition, check operation	D		X
Thermostats, inspect and check operation(2)			X
Water pump, replace (more frequent if water pressure loss or overheating occurs)			X

(1) Commercial use, heavy use, or use in salt or polluted water requires more frequent inspection and maintenance

(2) Emission-related component

(3) Annually in salt water applications

Engine Care Products

The engine care products listed in the table below are referenced in this service manual, and are recommended for use with *Evinrude E-TEC* G2 outboards.

A	*HPF Pro* Gearcase Lubricant	D	Hydraulic Fluid, P/N 770891.
B	*Power Trim/Tilt Fluid*, P/N 767969		*Anti-Corrosion Spray*
C	*Triple-Guard ®* Grease		*“6 in 1” Multi-Purpose Lubricant*

Maintenance

SERVICE TOOLS

Description	Part Number	Page
FLYWHEEL THREAD PLUG	P/N 357323	28
GEARCASE FILLER	P/N 501882	21
LIFTING FIXTURE	P/N 357667	27
NUT AND KEEPER ASSEMBLY	P/N 5010505	49
OETIKER PINCERS	P/N 787145	17
PROPELLER HUB KIT	P/N 5010529	49
WATER PRESSURE TRANSDUCER KIT	P/N 5011305	33

SERVICE PRODUCTS

Description	Part Number	Page
“6 IN 1” MULTI-PURPOSE LUBRICANT	P/N 777192	24
ANTI-CORROSION SPRAY	P/N 777193	24
DIELECTRIC GREASE	P/N 503243	22
ENGINE TUNER	P/N 777185	23
EVINRUDE 2+4 FUEL CONDITIONER	P/N 766216	24
HPF PRO GEARCASE LUBRICANT		21
HYDRAULIC FLUID	P/N 770891	35
TRIPLE GUARD GREASE	P/N 508298	16, 19, 22, 49

Batteries

⚠ WARNING

Battery electrolyte is acidic—handle with care. If electrolyte contacts any part of the body, immediately flush with water and seek medical attention.

Each outboard requires its own starting battery. Select a battery that meets or exceeds the minimum requirements.

Battery Recommendations

Outboard Model	Battery Rating
115–150 HP	675 CCA (845 MCA), or 800 CCA (1000 MCA) below 32°F (0°C) 107 amp-hr in extreme applications

Battery Location

Proper installation will prevent battery movement while underway.

- Secure all batteries in protected locations
- Place battery as close to the outboard as possible
- Battery location must provide access for periodic maintenance
- Use battery mounting trays or battery boxes on all battery installations
- Connections and terminals must be covered with an insulator
- Battery connections must be clean and free from corrosion
- Read and understand the safety information supplied with the battery before installation

Battery Connections

⚠ WARNING

Keep the battery connections clean, tight, and insulated to prevent their shorting or arcing and causing an explosion. If the battery mounting system does not cover the connections, install protective covers. Check often to ensure connections stay clean and tight.

Check battery connections frequently. Periodically remove battery to clean and service connections.

- Confirm that battery meets the minimum engine requirements.
- Connections must be clean and tight.
- Observe all wiring connections prior to disassembly.

Disconnecting the Battery

Disconnect battery negative (–) cable first and the battery positive (+) cable last.

Clean all terminals, battery posts, and connectors with a solution of baking soda and water. Use a wire brush or battery terminal tool to remove corrosion buildup. Rinse and clean all surfaces.

Connecting the Battery

NOTICE

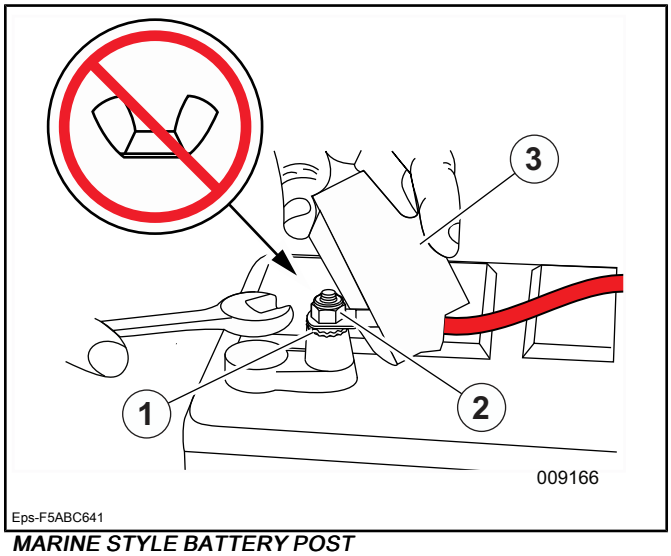
Do not use wing nuts to fasten ANY battery cables. Wing nuts can loosen and cause electrical system damage not covered under warranty.

IMPORTANT: Connect the battery positive (+) cable to the battery positive (+) post FIRST. Connect the battery negative (–) cable to the battery negative (–) post LAST.

1. Install a starwasher on the threaded battery post.

NOTE: Stack cables from the outboard, then cables from accessories.

2. Finish this connection with a hex nut.



MARINE STYLE BATTERY POST
1. *Starwasher*
2. *Hex nut*
3. *Terminal insulator*

3. Tighten all connections securely.

Required Chemical
Triple Guard Grease **P/N 508298**

4. Apply *Triple Guard Grease* to prevent corrosion.

Oetiker Clamp Servicing

⚠ WARNING

DO NOT reuse *Oetiker* clamps. Fuel leakage could contribute to a fire or explosion.

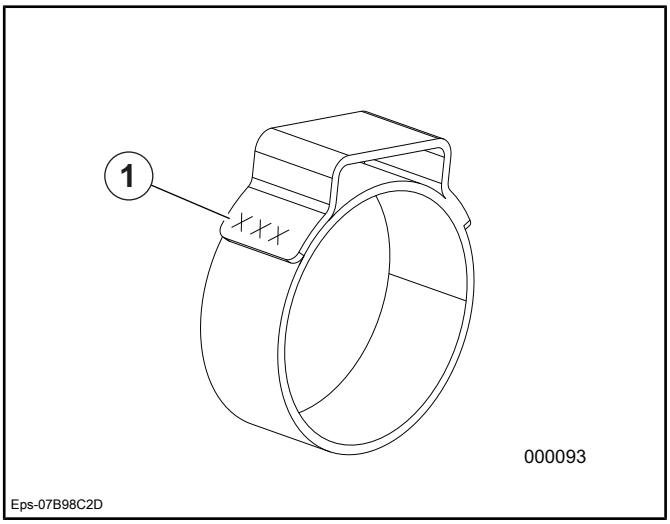
See the Oetiker Clamp Chart, page 51.

Clamp Identification

Use *Oetiker* clamps for making hose connections. These clamps provide corrosion resistance, minimize the potential for abrasion of rigging components, and provide solid, permanent connections.

The selection and installation of an *Oetiker* clamp is essential in the proper sealing of hose connections.

The clamp identification numbers appear on the side of the clamp, near the top of the ear. Refer to ***Oetiker* Clamp Chart** for clamp dimensions.



1. Clamp identification numbers

Clamp Selection

To select the correct size *Oetiker* clamp, measure the outside diameter of the hose when installed on the fitting.

Chose a clamp so that the outside diameter of the hose is approximately in the middle of the clamping range of the clamp.

Refer to the ***Oetiker* Clamp Chart**.

Clamp Installation

A constant stress should be applied to close the ear clamps. This method ensures a positive stress

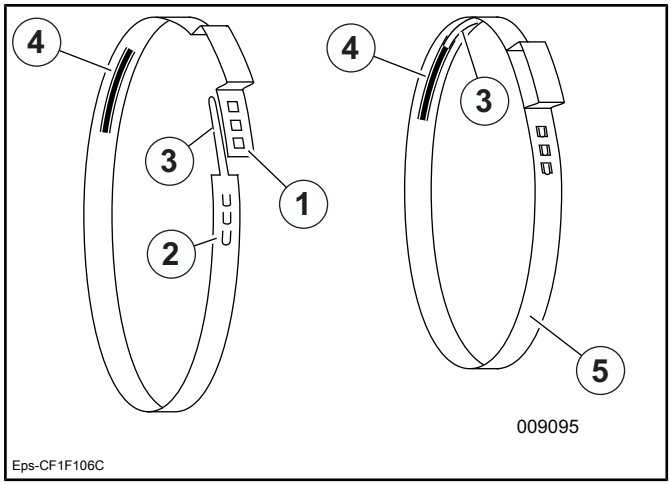
on the hose and does not result in excessive compression or expansion of the band material.

IMPORTANT: Use only *Oetiker* recommended tools to close *Oetiker* stepless clamps.

Oetiker pincers, P/N 787145, are available in the *Evinrude Genuine Parts and Accessories Catalog*.

1. Position correct size clamp over hose.
2. Install hose on fitting

NOTE: Larger size *Oetiker* clamps may come apart during handling. To reassemble the clamp, connect the end loop to the end hook. Make sure the alignment tab is installed into the alignment slot.

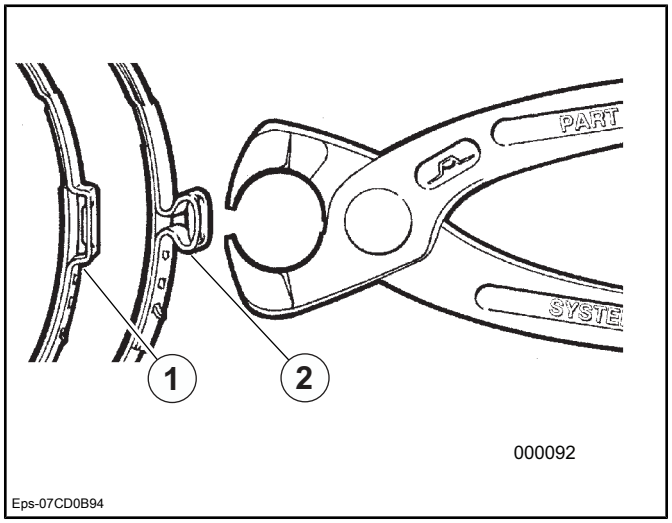


1. *End loop*
2. *End hook*
3. *Alignment tab*
4. *Alignment slot*
5. *Correctly assembled clamp*

3. Close clamp ear fully with *Oetiker* pincers (pliers).

Required Tool
Oetiker Pincers
P/N 787145

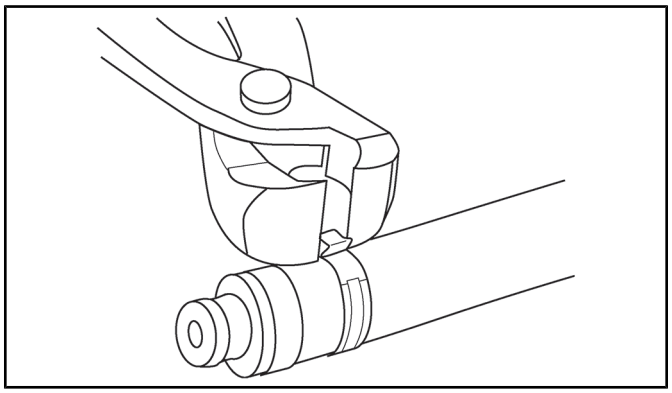
4. Position correct size clamp over hose.
5. Install hose on fitting.
6. Close clamp ear fully with *Oetiker* pincers (pliers).



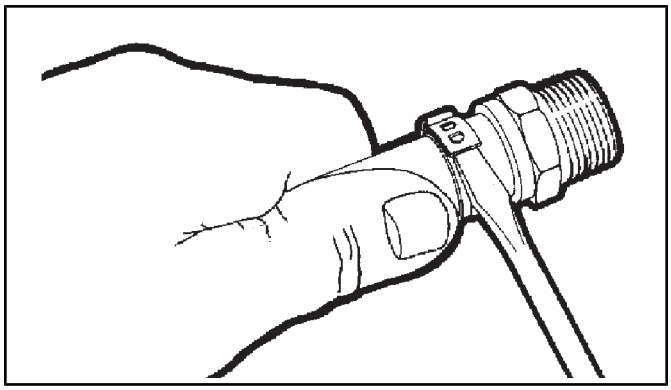
1. *Open clamp*
2. *Closed clamp*

Clamp Removal

Method 1: Position *Oetiker* pincers across clamp ear and cut clamp.



Method 2: Lift end of stepless clamp with screwdriver.



Use *Oetiker* pincers (pliers) to grip clamp. Pull clamp off of connection and discard.

Cooling System

Check the condition of cooling system components regularly:

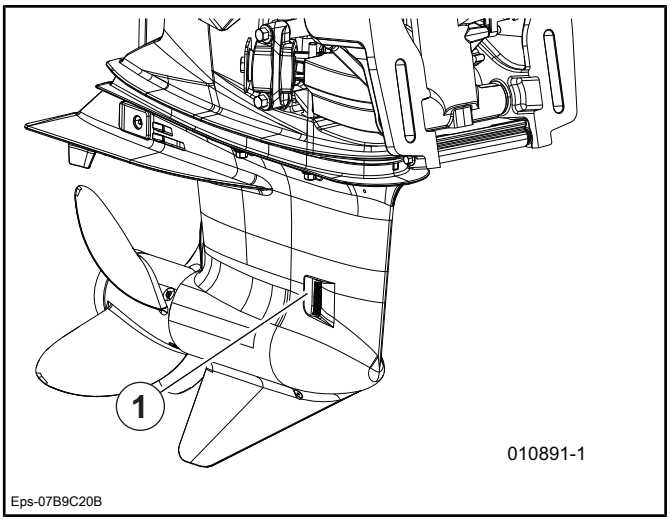
- water intake screens
- water pump
- all internal water passages
- thermostats
- all external water hoses and fittings
- vapor separator cooling passages and fittings
- *EMM* cooling passages and fittings
- overboard water pressure indicator

Water Intake Screens

Inspect condition of water intake screens. Clean or replace as needed.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the water screens.

Install water screens with one screw. Tighten screw to a torque of 18 to 30 In. lbs. (2 to 3.4 N·m).



1. Water intake screens

Confirm function of overboard water pressure indicator.

Engine Flushing

Flush the outboard with fresh water following each use in brackish, salt, or polluted water to minimize the accumulation of scale and silt deposits in cooling system passages.

The outboard can be flushed on the trailer or at dockside; running or not running.

IMPORTANT: The outboard must be located in a well ventilated area with appropriate ground drainage during the flushing procedures.

Keep water inlet pressure between 20 to 40 psi (140 to 275 kPa).

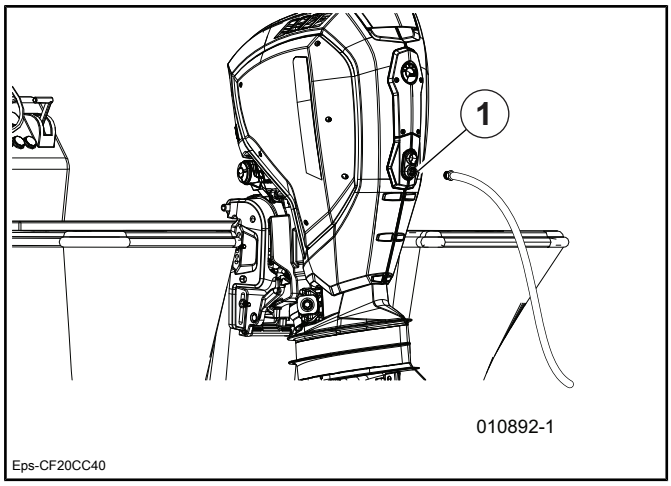
Flushing — Outboard Running

⚠ WARNING

To prevent injury from contact with rotating propeller, remove the propeller before flushing.

Place outboard in VERTICAL (DOWN) position in a well ventilated area.

Thread garden hose into flushing port.



1. Flushing port

Turn water supply on.

Run outboard at IDLE only until full operating temperature is reached.

Leave the outboard in VERTICAL (DOWN) position long enough for the powerhead to drain completely.

Reinstall propeller.

Flushing — Outboard Not Running

Place outboard in VERTICAL (DOWN) position.

Thread garden hose into flushing port.

Turn water supply ON.

Flush outboard for at least five minutes.

Turn off water supply and remove garden hose.

Leave the outboard in VERTICAL (DOWN) position long enough for the powerhead to drain completely.

Propeller Shaft

Debris from the water can become lodged around propeller shaft. Frequent inspection can minimize potential gearcase damage.

⚠ WARNING

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

1. Remove propeller. Refer to **Propeller Hardware Installation**.
2. Inspect bushing and blade surfaces. Replace damaged or worn propellers.
3. Clean propeller shaft.
4. Inspect propeller shaft seals. Replace damaged or worn seals.
5. Apply *Triple-Guard Grease* to entire length of propeller shaft prior to installing propeller.

Required Chemical
Triple Guard Grease **P/N 508298**

6. Reinstall propeller hardware and propeller.

Gearcase Lubricant

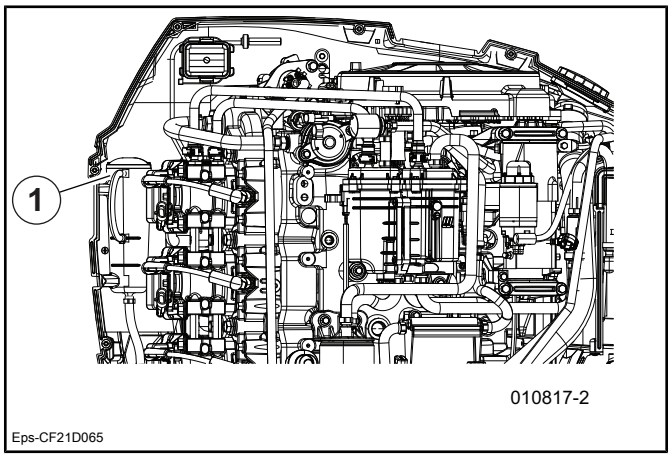
Refer to the**Inspection and Maintenance Schedule** for service intervals.

Lubricant Level

Refer to the **Inspection and Maintenance Schedule** for service frequency.

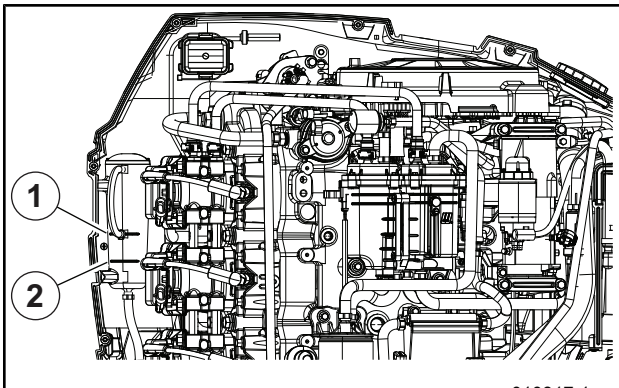
Remove the starboard side panel.

IMPORTANT: ALWAYS check the fill level of the gearcase lubricant at the oil reservoir before removing the drain/fill plug.



1. Lubricant reservoir

– Lubricant level should be between marks as shown.



LUBRICANT LEVEL

1. *Maximum mark*
2. *Minimum mark*

If the lubricant level is low, refer to the **Gearcase Leak Test**.

Draining

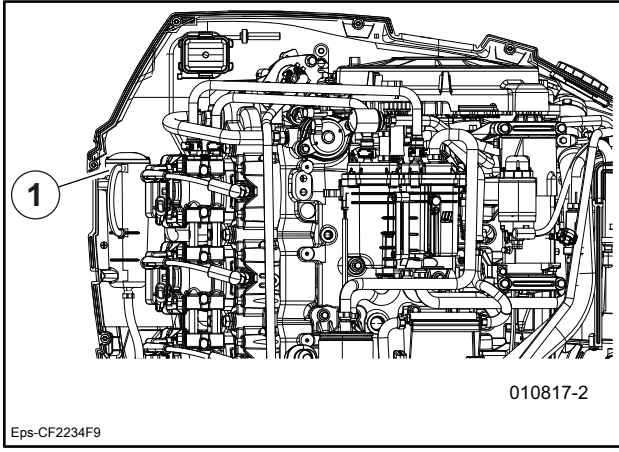
⚠ CAUTION

Gearcase lubricant may be under pressure and/or hot if outboard was recently operated or if gearcase lubricant is above the Maximum level.
Wear safety glasses and take precautions to avoid injury when removing vent hose from reservoir upper fitting.

ENVIRONMENTAL NOTE

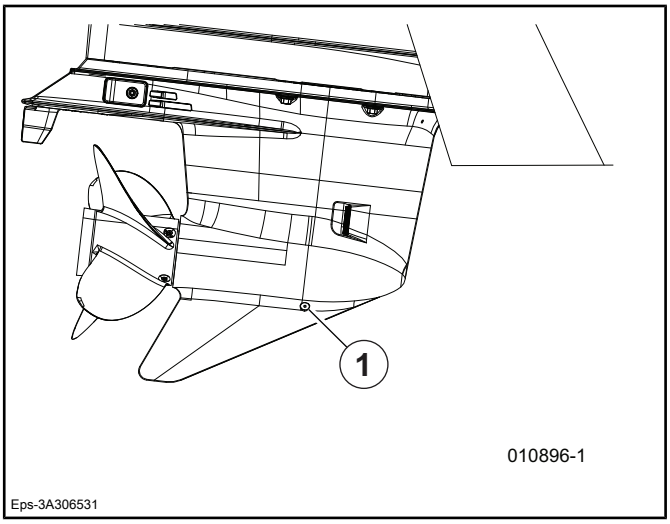
Dispose of used oil or oil contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Carefully remove vent hose from the reservoir upper fitting.



1. *Vent hose upper fitting.*

Remove remove the lubricant drain/fill plug. Drain the lubricant from the gearcase into a suitable container.



1. *Lubricant drain/fill plug*

Trim the engine up slightly to completely drain lubricant from the gearcase. Use shop towels to clean up any spilled oil.

Inspection

Inspect the lubricant for metal chips. The presence of metal **fuzz** can indicate normal wear of the gears, bearings, or shafts within the gearcase. Metal **chips** can indicate extensive internal damage.

Inspect the lubricant for water contamination. Water can make the lubricant milky in appearance. However, normal aeration can also cause the same appearance.

To check for water contamination, put lubricant into a clear container. Allow the oil to settle for a minimum of one hour to determine if there is an abnormal amount of water in the oil.

If water is present, refer to **Gearcase Leak Test**.

Overheated lubricant will have a black color and burned odor.

Internal gearcase inspection is recommended when lubricant is contaminated or shows signs of failure.

Filling

Refer to **Service Specifications** for lubricant capacities.

IMPORTANT: The recommended gear lubricant is formulated for marine applications. Do not use automotive gear lubricants, engine oils, or any other oil or grease.

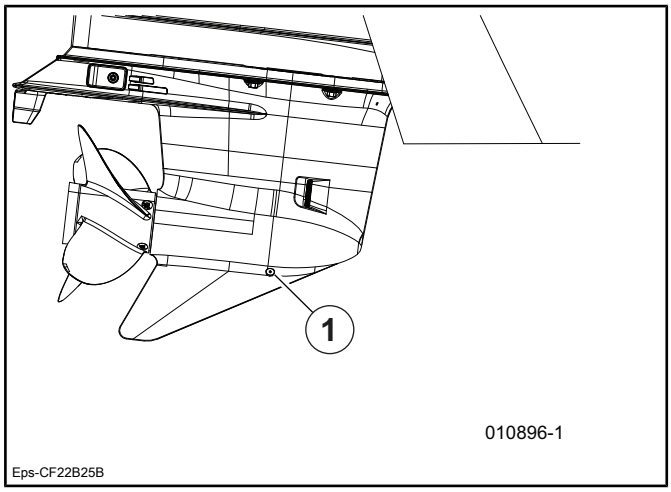
1. Secure the gearcase in a vertical position.
2. Use Gearcase Filler, P/N 501882, to slowly fill the gearcase with HPF Pro™lubricant until lubricant level in the reservoir is between the marks as shown in **Lubricant Level**.

Required Tool
Gearcase Filler P/N 501882

Required Product
HPF Pro Gearcase Lubricant

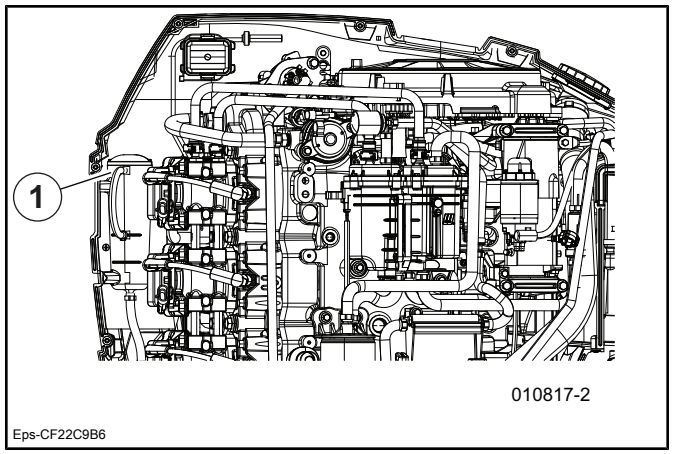
IMPORTANT: Filling the gearcase too quickly can cause air pockets and the gearcase may not fill completely.

3. Clean plug seal area and install the lubricant drain/fill plug and a **new** seal. Tighten the plug to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).



1. Lubricant drain/fill plug

4. Install the vent hose on the reservoir upper fitting.



1. Vent hose upper fitting

5. Install the starboard side panel.

Spark Plugs

Spark plugs should be removed and examined periodically. Replace worn, fouled or damaged spark plugs.

Use only recommended spark plugs with the correct gap setting.

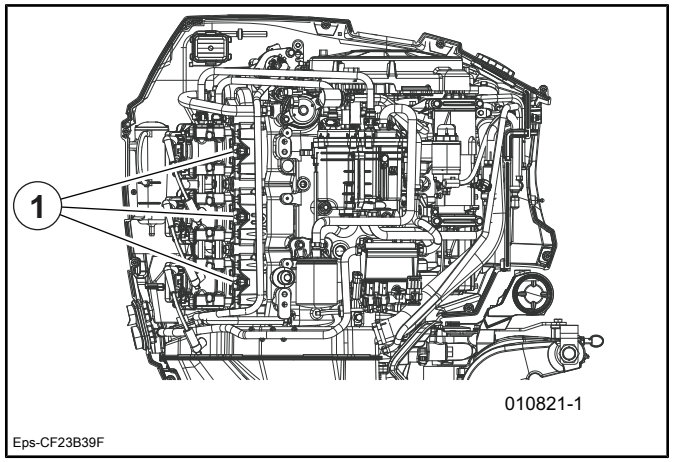
Spark Plug, *Champion*
QC10WEPIA @ 0.028 ± 0.003 in. (0.76 mm)

Removal

Remove the engine top cover and starboard frame. Refer to **Engine Cover and Frame Service**. Remove spark plugs and inspect condition.

Spark Plugs

Remove the spark plug leads from the spark plugs.



1. Spark plugs

Use a spark plug socket, extension and wrench to remove the spark plugs.

Installation

The cylinder heads of *Evinrude E-TEC G2* models are manufactured with indexed spark plug threads. **QC10WEPIA** spark plugs do NOT require indexing of the spark plug.

1. Set spark plug gap on new, replacement spark plugs.
2. Apply *Triple Guard Grease* to the gasket surface of the spark plug.

Required Chemical
Triple Guard Grease **P/N 508298**

3. Use a spark plug socket to install spark plug hand tight.

NOTE: Make sure the gasket of the spark plug is contacting the cylinder head.

4. Install a wrench on the spark plug socket and continue to tighten:
   - a new spark plug approximately 180 degrees.
   - a reused spark plug approximately 45 degrees.
5. Apply *Dielectric Grease* to the ribbed portion of the spark plug ceramic and to the opening of the spark plug cover to prevent corrosion.

Required Chemical
Dielectric Grease **P/N 503243**

6. Install the spark plug leads onto the spark plugs.

Install starboard frame. Then install the engine top cover. Refer to **Engine Cover and Frame Service**.

Fuel and Oil Systems

⚠ WARNING

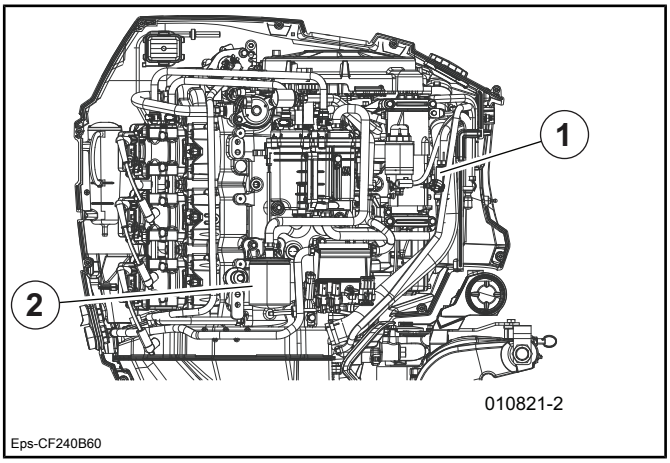
Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

Routine replacement of filters reduces the possibility of foreign material restricting the incoming fuel or oil supplies.

Replacement filter elements are available through *Evinrude Genuine Parts*.

Fuel Filters

Evinrude E-TEC G2 model outboards are equipped with an inline fuel filter and a water-sensing, water-separating fuel filter. Refer to **Fuel Component Servicing**.

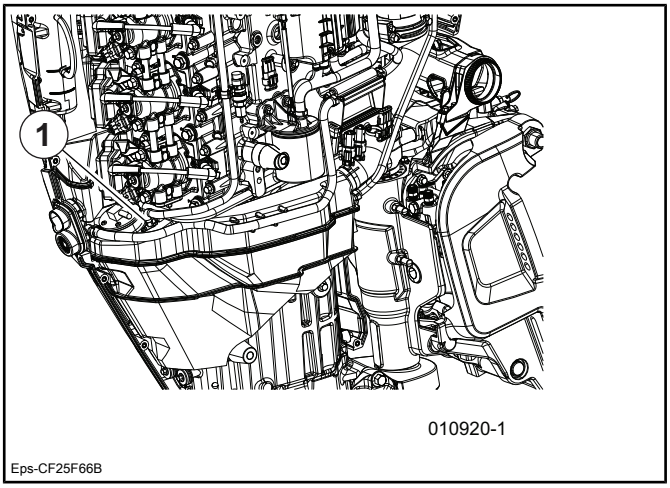


1. Inline fuel filter
2. Water-separating fuel filter

Oil Reservoir

Perform visual inspections to identify oiling system leaks. Make certain the oil tank is filled and oil supply is not contaminated.

A serviceable screen is located on the oil pick up at the rear of the on-engine oil tank.



1. Oil pick up

Hoses and Connections

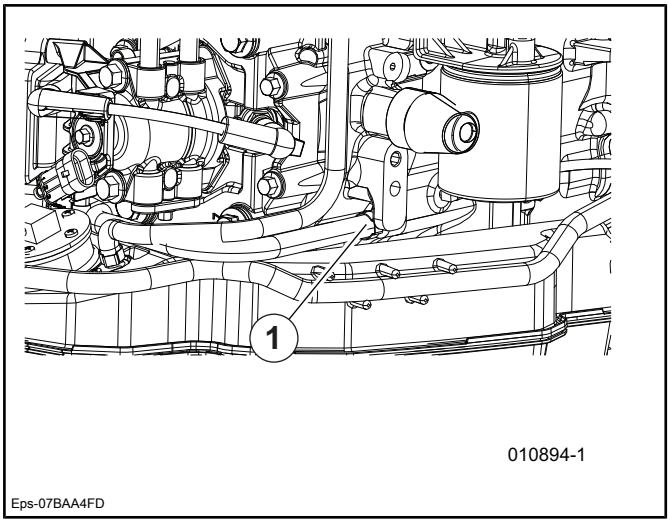
Check condition of all hoses and connections in both the fuel and oil systems:

- Visually inspect all components.
- Observe all clamps, hoses, and connections while outboard is running.
- Replace all damaged components.

– Repair all leaks.

Exhaust Pressure Fitting

The exhaust pressure fitting is threaded into the rear of the cylinder block and protrudes into the exhaust passage.



1. Exhaust pressure fitting

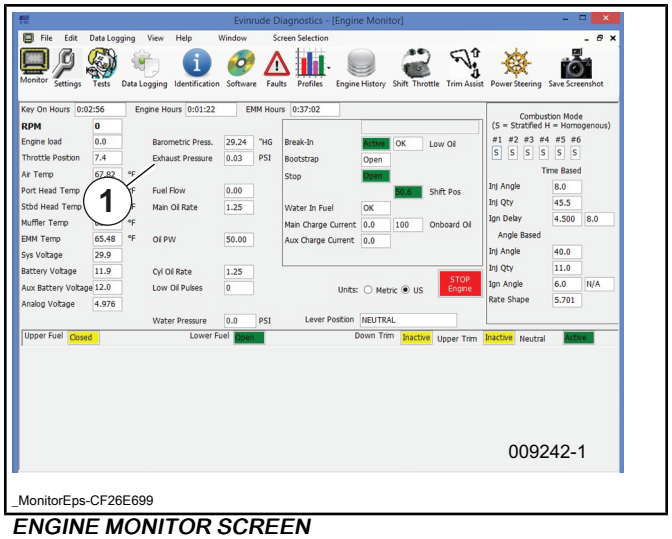
A hose is routed from this fitting to the *EMM*. Due to carbon accumulation in the exhaust, this fitting must be periodically de-carbonized or replaced.

Operation Test

Use the *Evinrude Diagnostics* software *Monitor* screen to confirm:

– barometric pressure reading
– changes in exhaust pressure reading

1. With key ON, outboard NOT running, make sure the barometric pressure reading reflects actual atmospheric conditions.
2. Remove exhaust/barometric pressure hose from *EMM* and retest using *Engine Monitor* screen if barometric pressure reading is inaccurate.
3. Replace hose and diaphragm assembly and inspect exhaust fitting for restriction if barometric pressure reading is accurate
4. Clean or replace exhaust pressure fittings if the exhaust pressure readings are not as described,



ENGINE MONITOR SCREEN

1. Barometric and Exhaust pressure readings

Cleaning

⚠ WARNING

Wear safety glasses to avoid personal injury, and set compressed air pressure to less than 25 psi (172 kPa).

1. Spray *Engine Tuner* through the fitting and allow it to soak for four to six hours.

Required Chemical
Engine Tuner **P/N 777185**

Cleaning with *Engine Tuner* maintenance product can dissolve carbon build-up.

2. Use compressed air to blow through the fitting.
3. Confirm movement of air through fitting.

IMPORTANT: The fitting does restrict air movement.

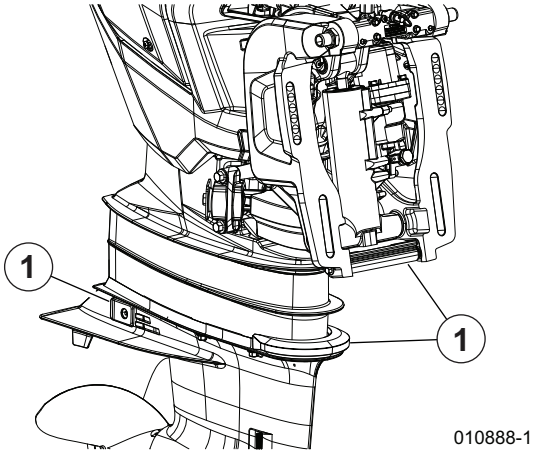
4. REPLACE any exhaust pressure fitting that is blocked and cannot be cleaned with *Engine Tuner*.

Anti-Corrosion Protection

Sacrificial Anodes

Galvanic corrosion occurs in fresh or salt water. Salt, brackish, and polluted water can accelerate corrosion. “Sacrificial” anodes are intended to protect the underwater metal components of the outboard from galvanic corrosion.

Outboards are equipped with two sacrificial anodes.



1. Trim and tilt anode
2. Stern bracket anode

Visually inspect anodes and metal components below water level. Erosion of anodes is normal and indicates the anodes are functioning properly.

IMPORTANT: Anodes that are not eroding may not be properly grounded. Anodes and the mounting screws must be clean and tight for effective corrosion protection.

For best anode performance:

– Replace all anodes that have eroded or disintegrated to two-thirds of their original size
– Do not paint or apply protective coatings to anodes or anode fasteners
– Avoid using metal-based antifouling paint on the boat or outboard

Testing Procedure — Continuity

1. Connect ohmmeter leads between engine ground and anode surface.

The meter should show little or no resistance. If resistance is high, check the following:

– Remove the anode and clean the area where the anode is installed
– Clean the mounting screws
– Install the anode and test again

Metal Component Protection

1. Use Anti-corrosion spray or “6 in 1” Multi-Purpose Lubricant to prevent corrosion on metal outboard components.

Required Chemicals
Anti-corrosion spray **P/N 777193**
“6 in 1” Multi-Purpose Lubricant **P/N 777192**

Exterior Finishes

Maintain the outboard’s exterior finish to prevent corrosion and reduce oxidation.

1. Use automotive wax to protect the outboard’s exterior finish from oxidation.
2. Clean regularly using clean water and mild detergent soap.
3. Touch-up damage to painted surfaces promptly.
4. Protect moving components with appropriate lubricants.

Storage

IMPORTANT: DO NOT start outboard without a water supply to the outboard’s cooling system. Cooling system and/or powerhead damage could occur.

Fuel System Treatment

1. Stabilize the boat’s fuel supply with *Evinrude* 2 +4® Fuel Conditioner following the instructions on the container.

Required Chemical
***Evinrude 2+4* Fuel Conditioner** **P/N 766216**

Internal Engine Treatment

1. Remove the propeller.
2. Attach a garden hose to the flushing port.
3. Turn on the water.

Throttle Control Method

1. With the key switch in the OFF position move the control lever (s) to the FORWARD wide open throttle position.
2. Turn the key switch to ON and wait a minimum of three seconds.
3. Attempt to start the outboard three times within three seconds.

NOTE: The starter will not engage or crank the outboard

4. Move the lever to NEUTRAL and start the outboard(s).
5. Run the outboards at idle for a minimum of three seconds.
6. With the outboard (s) running, attempt to start the outboard three times within three seconds.

NOTE: The starter will not engage or crank the outboard

7. The remote control will send the winterization message to each outboard.

NOTE: Only running outboard (s) will be winterized.

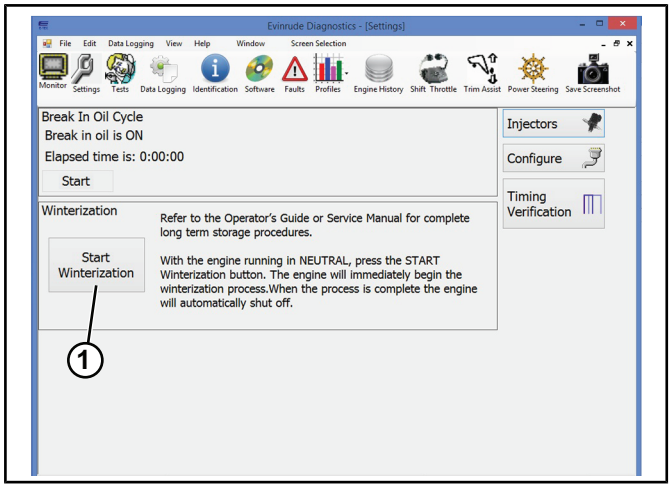
8. The outboard (s) will automatically shut off when the process is complete.

IMPORTANT: During the winterization process, the remote control will ignore all throttle, gear, and switch operations. The control WILL acknowledge Key OFF or Emergency Stop commands.

Software Control Method

Winterization can also be run using *Evinrude Diagnostics* software v 6.4 or higher.

1. With the outboard running, start the process at the *Settings* screen and follow the instructions.



1. Winterization start button

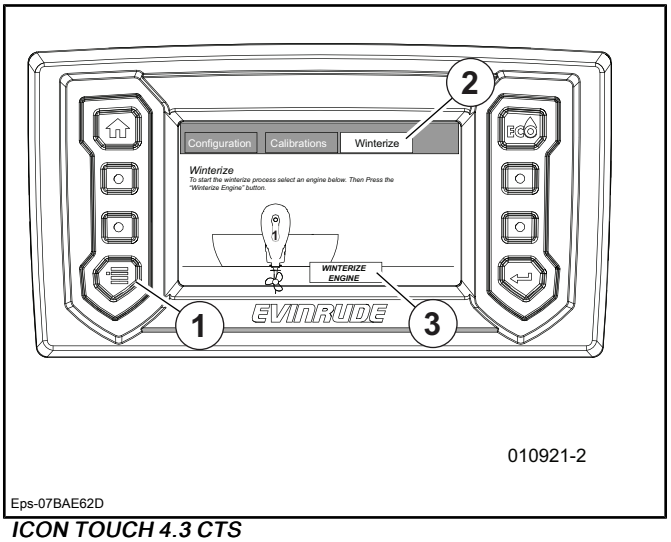
Digital Gauge Method

Digital displays provide a winterize feature for *Evinrude E-TEC G2* models.

Refer to the digital display user's guide for complete instructions. The outboard must be running in NEUTRAL at idle speed to perform the winterize procedure. Be sure to supply cooling water to the outboard before starting.

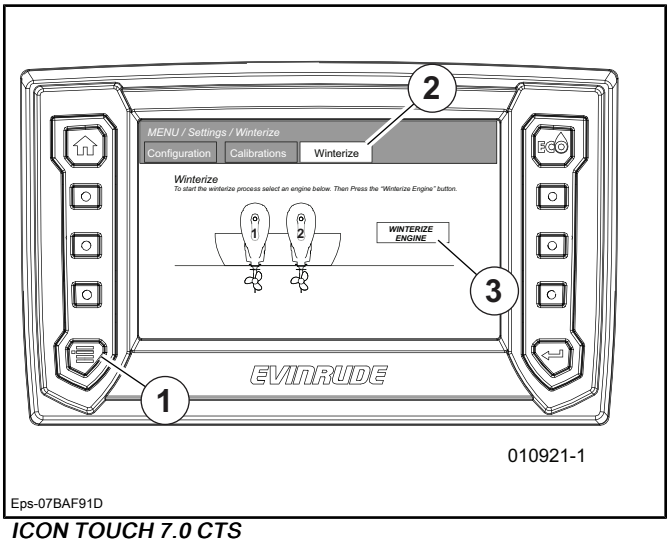
To access the winterize feature for the *ICON Touch 7.0 CTS* or *ICON Touch 4.3 CTS*:

– Press the MENU button, then touch the SETTINGS icon. Touch the WINTERIZE tab.
– "Mode Select" feature (*Nautilus 3.5CS*)



ICON TOUCH 4.3 CTS

1. Menu/Settings
2. Winterize tab
3. WINTERIZE ENGINE button

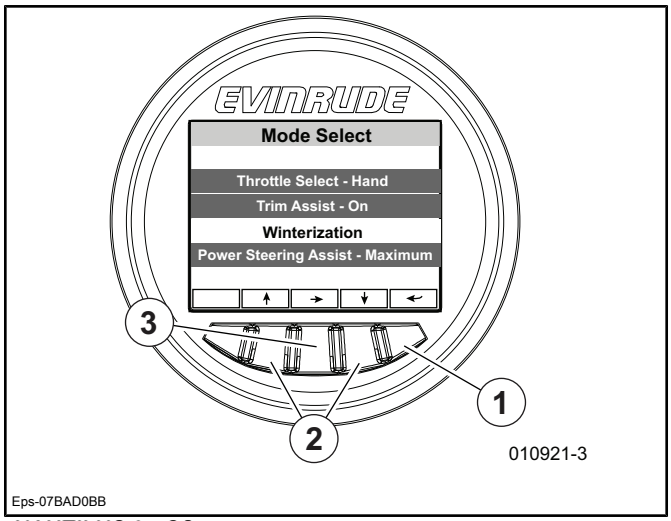


ICON TOUCH 7.0 CTS

1. Menu/Settings
2. Winterize Tab
3. WINTERIZE ENGINE button

To access the winterize feature for the *Nautilus 3.5CS*:

– Press the MODE SELECT button, then use the up and down buttons to select WINTERIZATION.
– Press the RIGHT arrow button to start the winterization.



NAUTILUS 3.5CS

1. *Mode select*
2. *Up and Down buttons*
3. *Right Arrow button*

After the outboard shuts itself off, turn the key switch OFF. If a flushing device was used to supply water, detach the water supply from the outboard.

IMPORTANT: When finished, leave the outboard in vertical position long enough to completely drain the powerhead.

Pre-Season Service

⚠ WARNING

Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

If the outboard was removed from the boat for storage, make sure it is reinstalled with factory specified hardware. Refer to the **Predelivery and Installation Guide**.

Outboard Mounting Bolts

- Check the lubricant level.
- Inspect gearcase for leaks. If leak is apparent, pressure and vacuum test gearcase.
- Repair gearcase as needed.

Battery(s)

- Replace batteries that cannot be charged.

Operational Checks

- Refer to **Operational Checks**
- Steering system
- Remote controls
- All other accessories and instrumentation

Check Oil Injection

- Inspect the oil tank for leaks

Check Oil Injection Tank

- Inspect the oil tanks for leaks

Check Fuel System

- Inspect entire fuel system for leaks prior to starting outboard
- Repair all leaks

Water Pump

Make sure a steady stream of water flows from overboard indicator

Lifting the Outboard

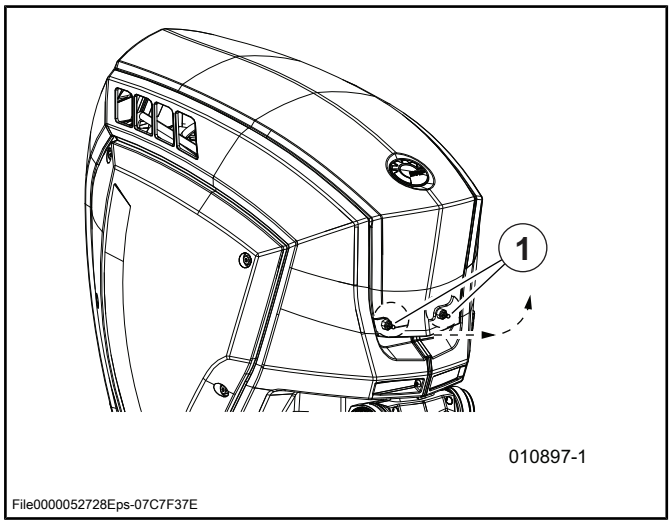
⚠ WARNING

To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

⚠ WARNING

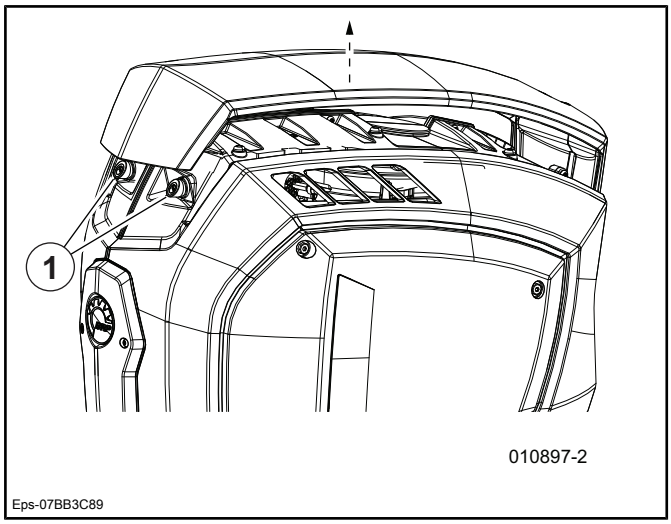
To avoid personal injury, or damage to the engine, boat or other property, install the lifting fixture completely into the flywheel.
To properly install the fixture, carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread or over–torque the fixture.
After the lifting fixture is installed, turn the flywheel clockwise until the off-set lifting eye of the fixture is in line to the back of the engine.
Make sure the lifting capacity of the hoist is at least twice the weight of the outboard.
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

1. Pull the lower edge of the front cover to release from the latch pins.



1. Front cover latch pins (inset)

2. Lift the cover to release from the rear bumpers and remove the cover.

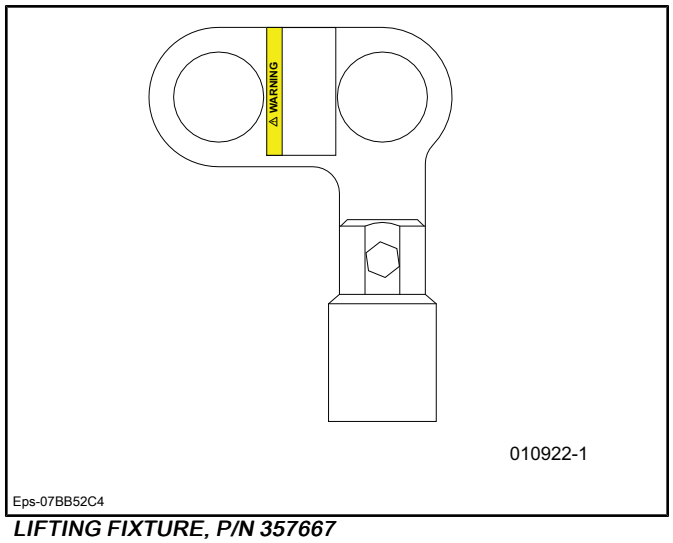


1. Rear bumpers

3. Use Lifting Fixture, P/N 357667, to lift the outboard.

Required Tool
Lifting Fixture **P/N 357667**

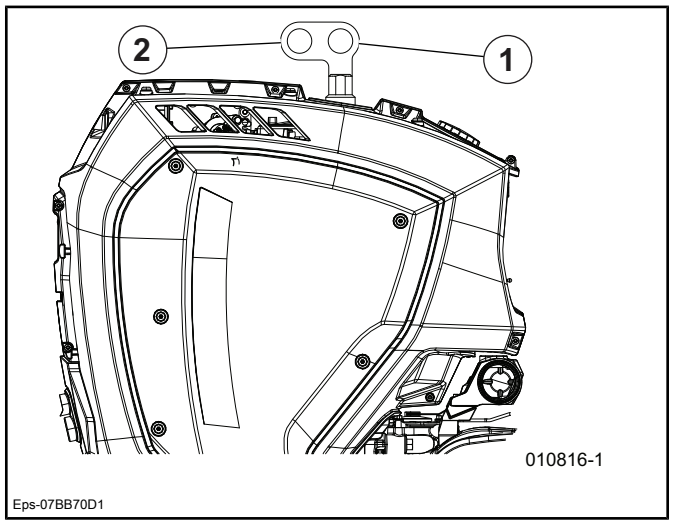
NOTE: The centerline lifting eye is used to lift the complete engine. The off-set lifting eye is used to remove and install the powerhead.



LIFTING FIXTURE, P/N 357667
1. Centerline lifting eye
2. Off-set lifting eye

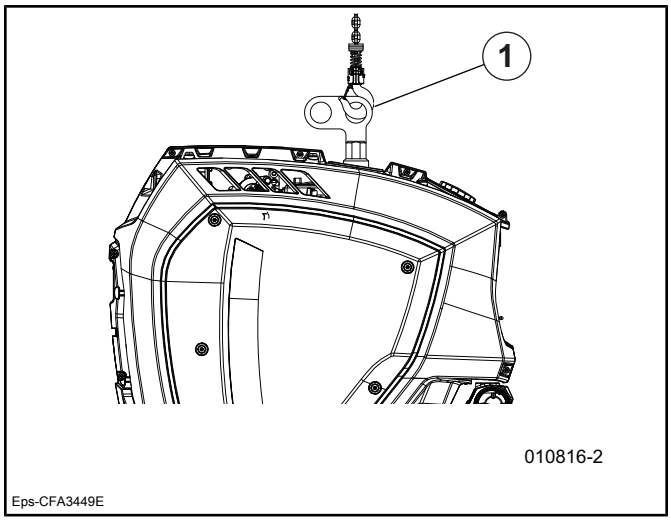
IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

4. Install the lifting fixture completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.



1. Center lifting eye
2. Off-set lifting eye

5. Fasten appropriate chain hook to the centerline lifting eye of the tool.



1. Centerline lifting eye

Plug Installation

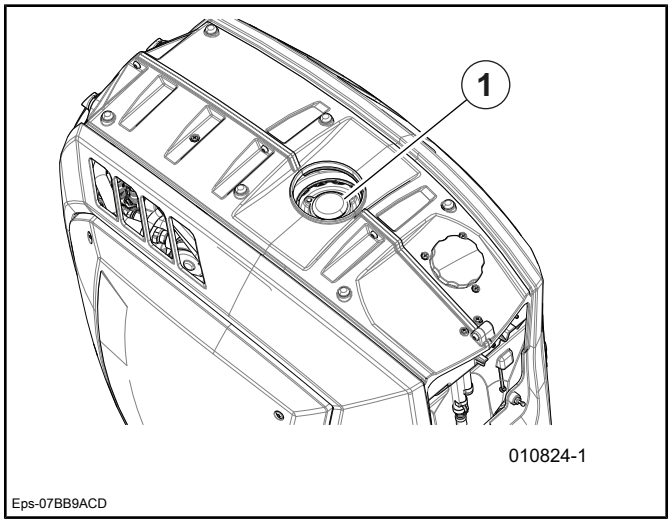
NOTICE

Install plugs as indicated. Plugs MUST be installed to prevent water entry and/or engine performance issues.
Make sure plugs are securely installed to prevent loosening during engine operation.

1. Apply *Triple Guard* grease to the threads of the flywheel.

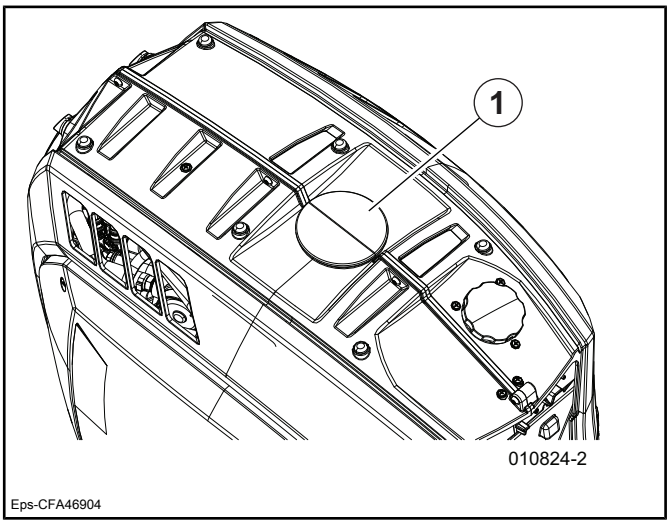
Required Tool
Flywheel Thread Plug
P/N 357323

2. Install the Flywheel Thread Plug, P/N 357323, to protect the threads from corrosion.



1. Flywheel thread protector

3. Install the Center Frame Plug, P/N 360646, to provide correct air flow to the engine.



1. Center frame plug

Rigging Information

Rigging related information in this section supports re-installation after completing service procedures.

Use the current ***Evinrude E-TEC G2 Installation and Predelivery Guide*** for complete installation details if installing a new engine package.

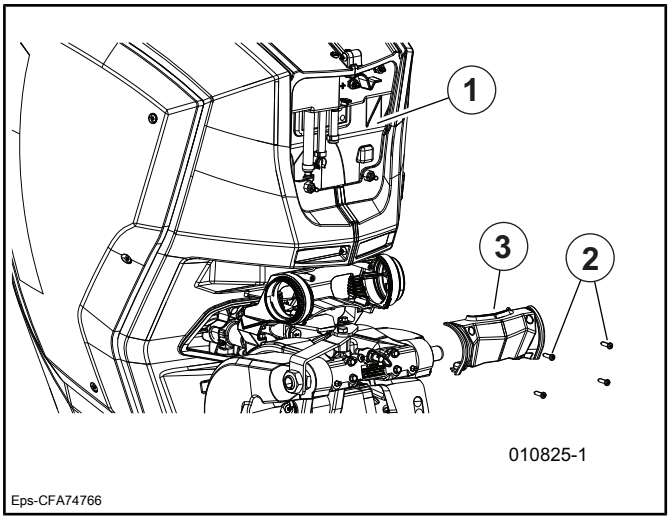
Rigging Center

Evinrude E-TEC G2 models utilize a central rigging center. All buss cables, hydraulic steering hoses, fuel and oil hoses and related rigging enter the rigging center through a cable entryway.

The cable entryway is configured for starboard cable entry but can be adapted for port cable entry if needed.

Remove the top cover to access the rigging center.

Remove four screws from the cable entry cover. Remove the rigging center covers.



1. *Rigging center*
2. *Four screws*
3. *Cable entry cover*

Rigging Hose Requirement

NOTICE

A 12 in. (304.8 mm) or longer length of rigging hose such as P/N 770392, P/N 770393, or P/N 362031 is REQUIRED to prevent damage to buss cables, hoses, harnesses or other wiring entering the outboard rigging center.

Rigging Hose Options

Allow one rigging hose per engine. The rigging hose can enter from the starboard or port side.

Cable and Hose Routings and Connections

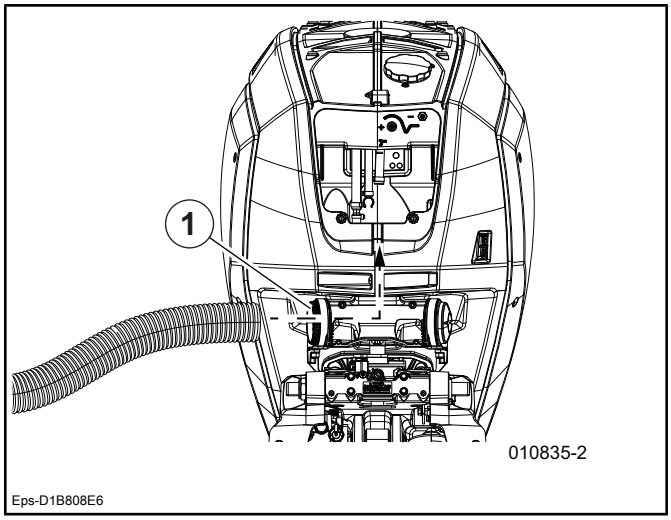
NOTICE

After installation, make sure there is enough clearance for all cables to avoid binding or chafing through all engine steering and tilting angles.

All hydraulic steering hoses, battery cables, buss cables, fuel and oil hoses and related rigging enter the rigging center through a cable entryway.

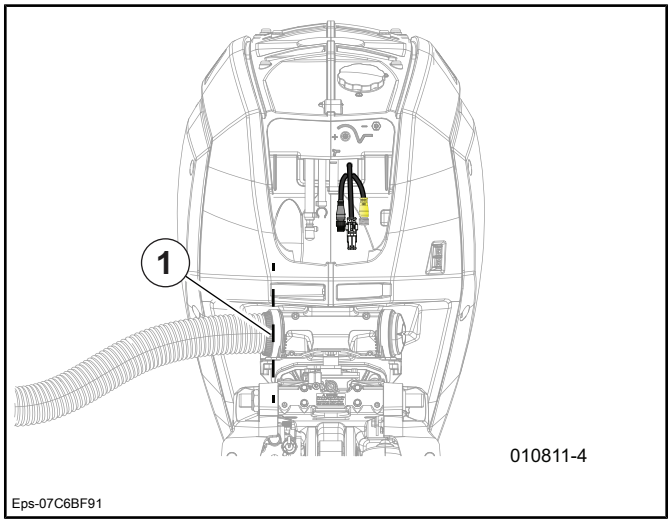
The cable entryway is configured for starboard cable entry and 2.0 in. (50.8 mm) rigging hose. The cable entryway can be adapted for 2.4 in. (61 mm) rigging hose if needed.

To Turn the retainer clockwise to remove from the cable entryway.



1. *Retainer*

Hose and cable lengths are measured from the cable entryway to the connection point in the rigging center. See **Rigging Center Hose and Cable Lengths**.



1. *Cable entryway point of measure*

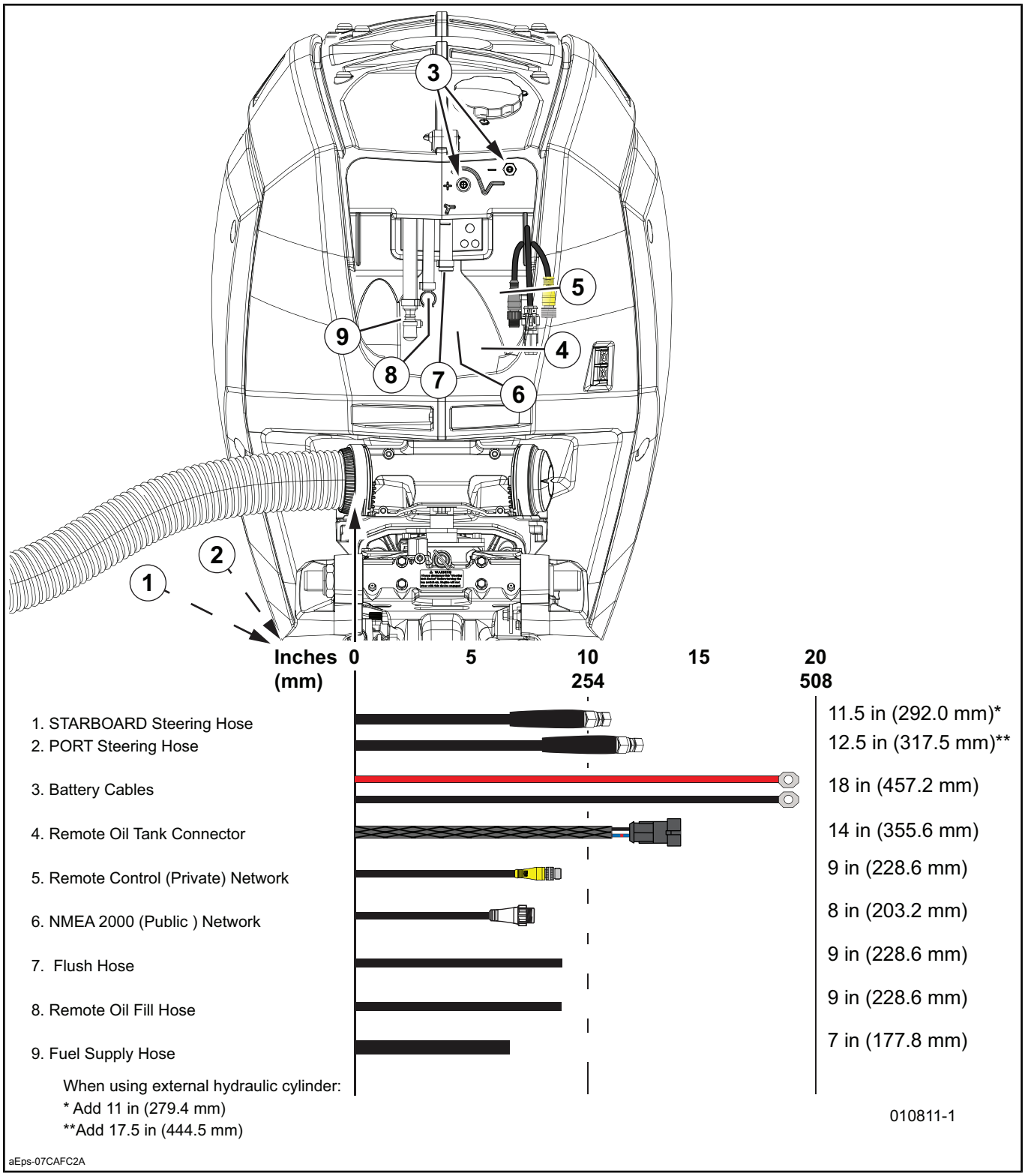
Route all steering hoses, battery cables, fuel and oil hoses, buss cables, and optional accessories such as auxiliary battery charging cable, or remote oil tank hose from the boat through a protective conduit into the rigging center cable entry.

When installing hoses and cables through the flexible tubing, install in this order:

1. steering hoses
2. battery cables
3. fuel hose
4. optional oil or flush hoses
5. buss cables
6. optional accessory connections

Rigging Center Hose and Cable Lengths

Use the dimensions listed as a guide for routing all cables and hoses.



Hydraulic Steering Hoses

⚠ WARNING

Incorrect connection of hydraulic hoses will cause the engine to steer in the opposite direction of the helm input.
This can result in loss of boat control and injury to the occupants.

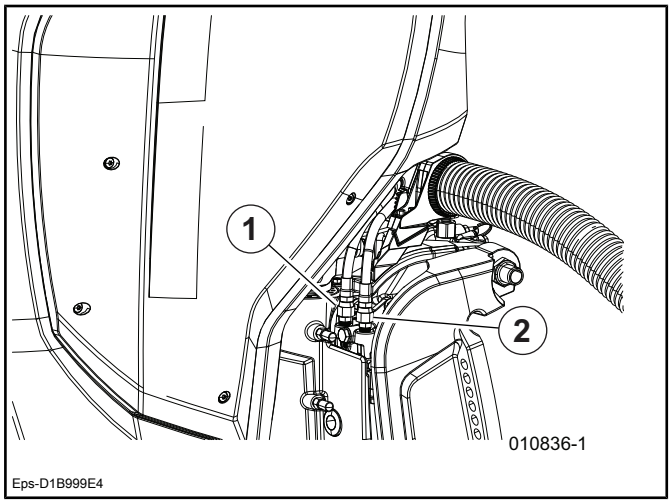
Hydraulic Hose Routing

First install the hydraulic steering hoses through the flexible conduit.

Hydraulic Hose Connections

Connect the PORT hydraulic hose from the helm to the PORT hydraulic steering fitting on the stern bracket. Tighten the nut by hand until fittings are seated.

Connect the STARBOARD hydraulic hose from the helm to the hydraulic steering fitting on the STARBOARD stern bracket. Tighten the nut by hand until fittings are seated.



1. *PORT hydraulic steering fitting*
2. *STARBOARD hydraulic steering fitting*

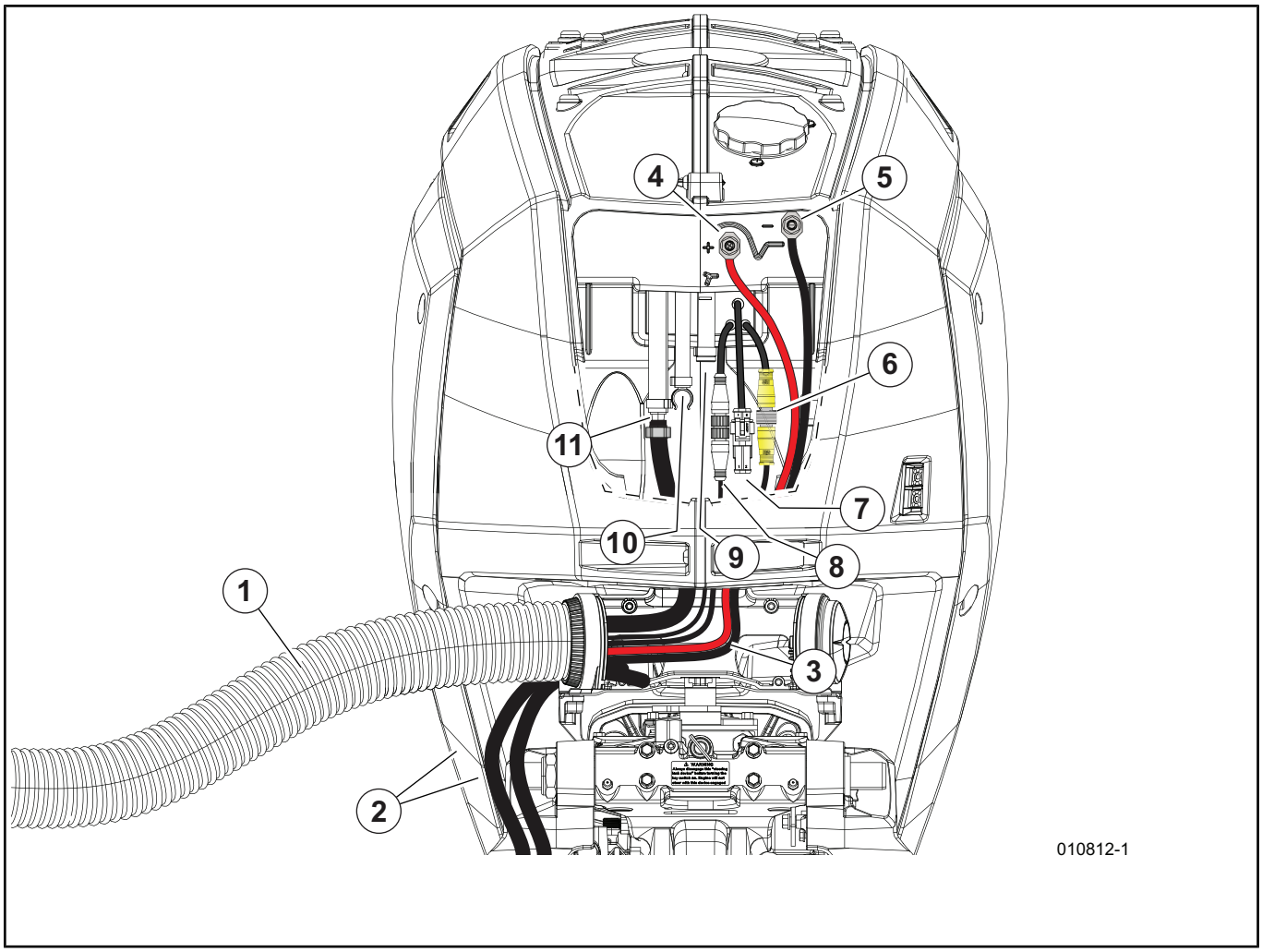
Tighten both hydraulic hose fittings to a torque of 15 ft. lbs (20.3 N·m).

Connections

Also see **Rigging Center Connections**.

1. Install the positive (**+**) battery cable to the positive stud (**+**) on the PORT frame. Tighten nut to a torque of 120 to 144 in.lb. (13.5 to 16.5 N·m).
2. Install the negative (**–**) battery cable to the negative stud (**–**) on the PORT frame. Tighten nut to a torque of 60 to 84 in.lb. (7 to 9.5 N·m).
3. Connect the fuel supply hose from fuel tank to hose fitting on the outboard. Secure hose with *Oetiker* clamp.
4. If installing optional remote oil tank, connect the oil supply hose from the oil tank to the fitting on the outboard. Secure hose with *Oetiker* clamp.
5. Connect the remote control network buss cable to the outboard's buss cable. Refer to **Network Connections**.
6. Connect the *NMEA 2000* buss cable from a tee in the boat to the outboard's *NMEA 2000* buss cable.
7. If installing optional remote oil tank, remove the protective cover from the harness on the outboard. Connect the electrical connector from the oil tank to the connector on the outboard.

Rigging Center Connections



1. Flexible Conduit
2. Steering Hoses
3. Battery Cables
4. Positive (+) Battery Stud
5. Negative (-) Battery Stud
6. Remote Control Network Cable
7. Remote Oil Tank Electrical Connector (optional)
8. NMEA 2000 Network Cable
9. Engine Flushing Hose (optional)
10. Remote Oil Tank Hose (optional)
11. Fuel Supply Hose

Water Pressure Connection

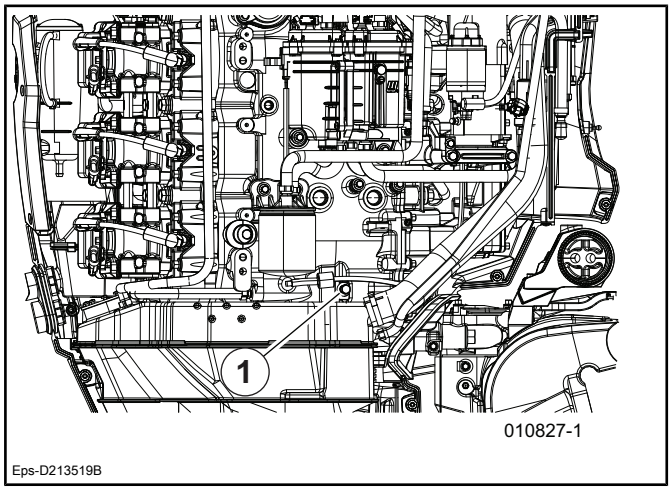
1. Install 50 psi Water Pressure Transducer Kit, P/N 5011305, to send water pressure data to the *EMM*. A *NMEA 2000* compatible display is also required for the operator to view water pressure information.

Required Tool
Water Pressure Transducer Kit **P/N 5011305**

NOTE: Water pressure readings in excess of 40 psi (275 kpa) are possible at boat speeds in excess of 50 mph (80 kph/43 kts).

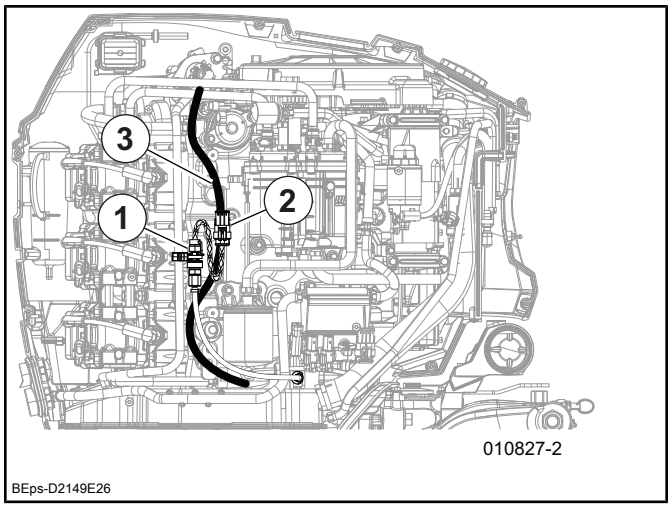
2. Remove the accessory water pressure plug from the engine. The plug is located forward of, and just below the water separating fuel filter.

IMPORTANT: Use the fittings and hose supplied with the kit. Do NOT install the transducer directly into the block.



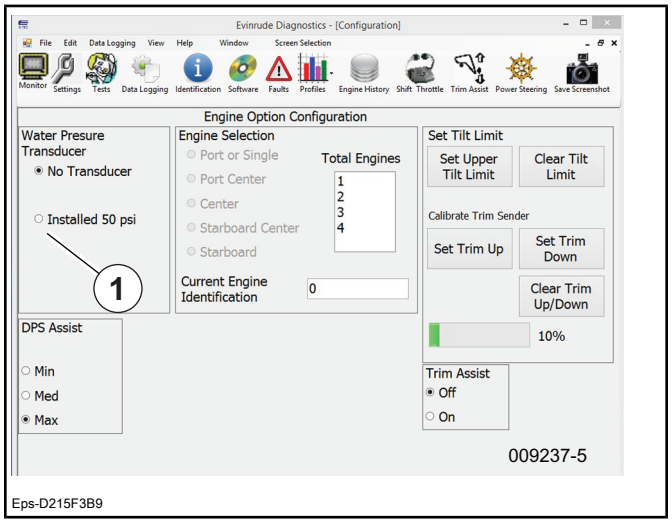
1. Accessory water pressure plug

3. Apply *Pipe Thread Sealing Compound*, P/N 764806, to the threads of the 1/8 NPT male fitting. Install the hose fitting into the accessory water pressure port and tighten securely.
4. Assemble the water pressure transducer as directed in the instructions provided with the kit. Attach the hose to the fitting and secure with a tie strap. Clip the transducer to the fuel hose. The transducer MUST be oriented as shown to allow water to drain.
5. Connect the electrical connector to the engine harness and install the connectors on the clip located on the harness.



1. Water pressure transducer
2. Electrical connector
3. Engine harness

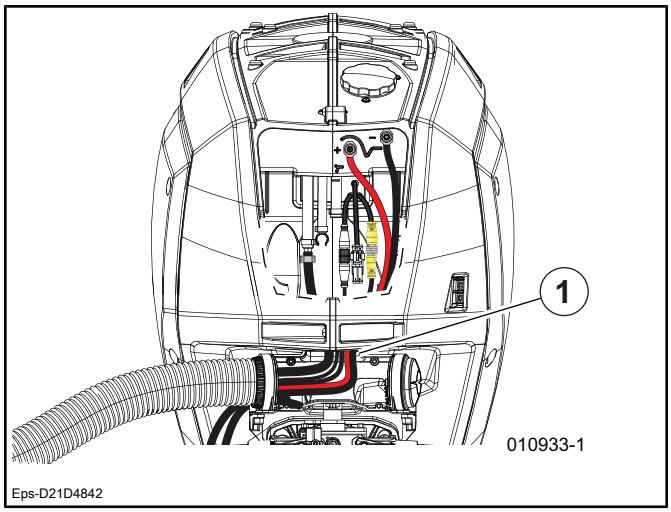
6. Use the *Configuration* screen of *Evinrude Diagnostics* software v 6.4 or higher to set the water pressure transducer.



1. Water pressure transducer

Final Assembly

1. Make sure there is loose slack in all hoses and cables.
2. If port cable entry is used, slack should be to the starboard side of the cable entryway.
3. If starboard cable entry is used, slack should be to the port side of the cable entryway (*shown below*)

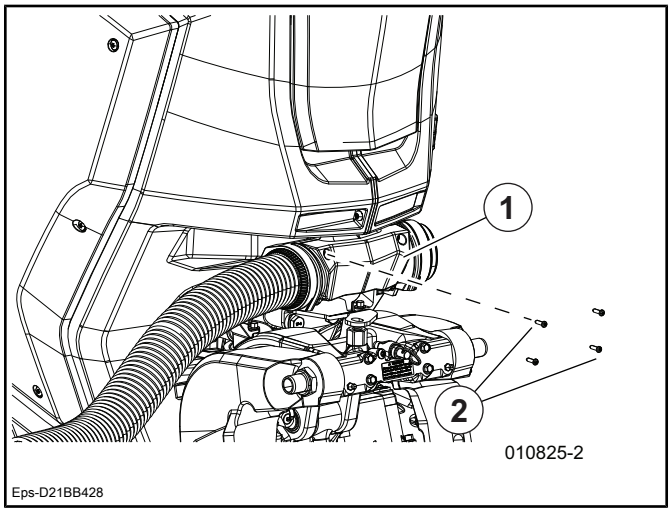


1. Slack

IMPORTANT: Hoses and cables should NOT bind or be pulled taught when engine is in a full turn.

4. Install cover on cable entryway with four screws.

NOTE: Make sure cables are not pinched between cable entryway cover and housing.



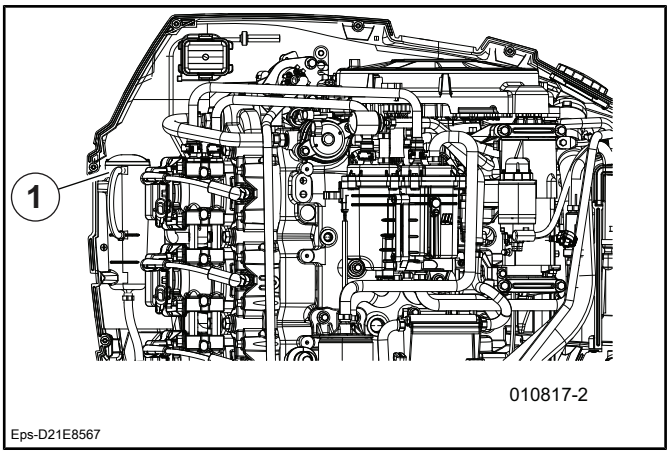
1. Cover
2. Screws

5. Install the engine covers. Refer to **Engine Cover and Frame Service**.

Before Start-Up

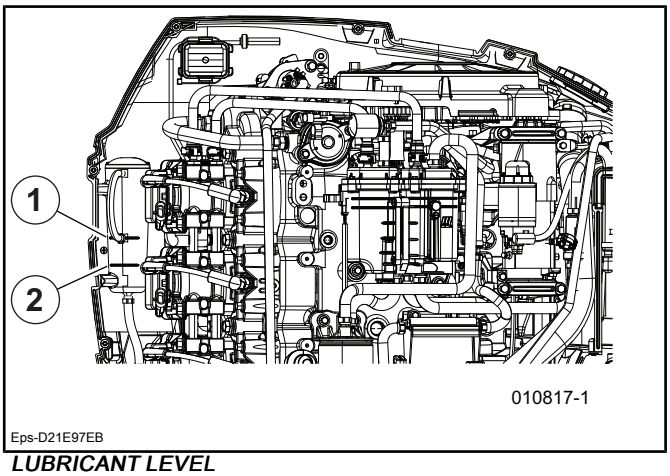
Gearcase Lubricant

– Inspect the lubricant level in the lubricant reservoir.



1. Lubricant reservoir

– Lubricant level should be between the marks as shown.



LUBRICANT LEVEL
1. Maximum
2. Minimum

Add *HPF Pro* Gearcase lubricant if needed.

2–Stroke Engine Oil Level

Make sure the outboard is in the vertical position when checking oil level. Use the digital gauge or display to check the oil level. Make sure the onboard oil tank contains an adequate supply of the correct lubricant for the outboard. Refer to **Recommended Lubricants**.

Trim and Tilt Fluid

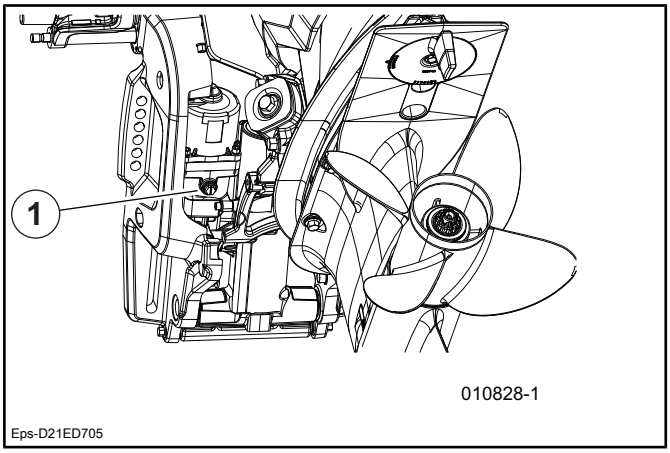
⚠ CAUTION

Correct fluid level must be maintained to ensure operation of the impact protection built into the unit.

The trim and tilt system is filled, tested and sealed at the factory. It is NOT necessary to check fluid level.

Check the fluid level ONLY if the trim and tilt is NOT operating normally:

– Tilt the outboard to the full UP position.
– Remove filler cap and check fluid level.
– Add Power Trim/Tilt Fluid, P/N 767969, as needed, to bring level to the bottom of the fill plug threads.



1. Filler cap

Filling and Bleeding the Hydraulic Steering System

Hydraulic Steering Fluid

⚠ WARNING

Use ONLY approved hydraulic fluids. Non-approved fluids can cause steering system damage, or reduced steering control. This can result in loss of boat control and injury to the occupants.

1. Use SeaStar Hydraulic fluid HA5430, P/N 770891, or Hydraulic fluid meeting MIL SPEC: Mil-H-5606.

Required Product
Hydraulic Fluid P/N 770891

Single Station / Dual Engine Installations

Filling and bleeding dual engine installations is the same as single engine installations.

Follow the instructions found in Manual Method or the Power Purge Method.

Single Station Steering Installations

The following instructions describe the fill and bleed procedure for a single and dual outboard installation.

Manual Method

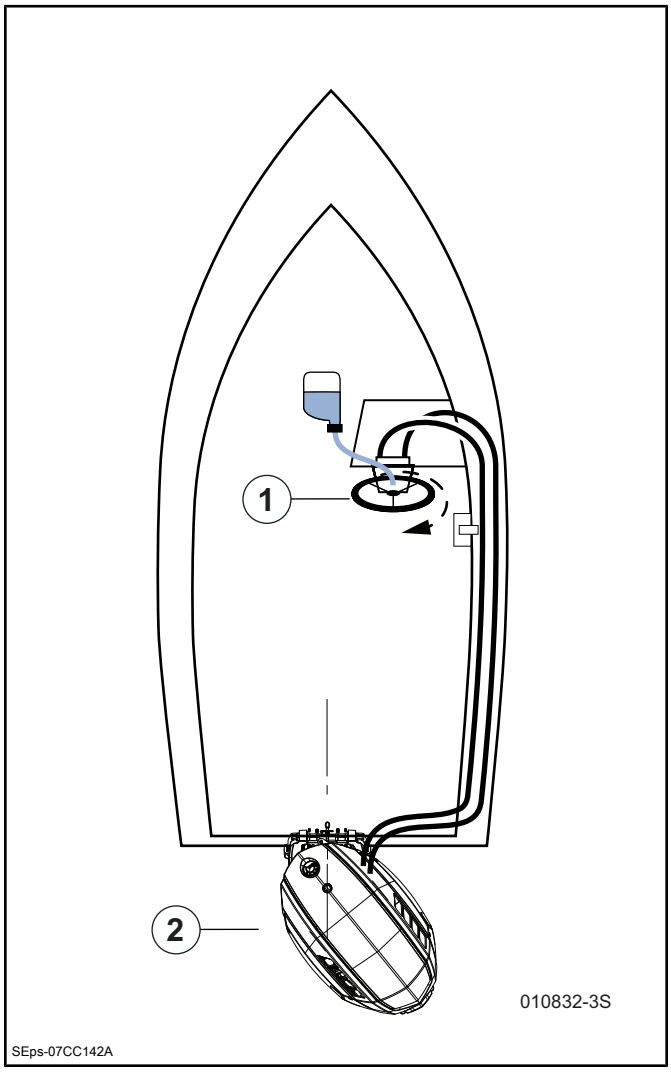
Also refer to the instructions provided with the hydraulic steering helm pump.

IMPORTANT: Turn the key switch to the ON position for models with DPS.

IMPORTANT: Make sure the outboard is trimmed to the full DOWN position before beginning this procedure. Air will NOT bleed completely from the steering system if the engine is even slightly trimmed up.

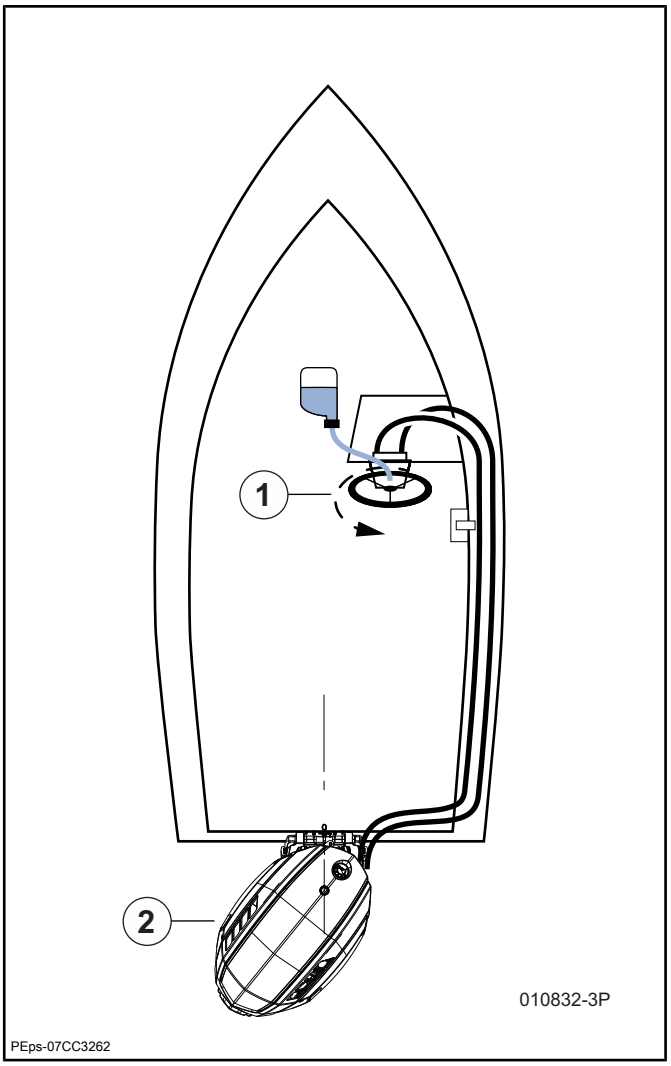
1. Remove the filler cap from the helm.
2. Install the threaded end of the filler tube (supplied with helm) into the helm.
3. Fill the helm with the recommended fluid. Fluid should always be visible in the filler tube. Use additional bottles of fluid as needed. Do NOT proceed with the next step until the helm is full of fluid.

4. Turn the steering wheel clockwise until the outboard is turned fully to STARBOARD and resistance is felt. Be sure to maintain fluid level at the helm/reservoir.



1. Turn the steering wheel clockwise
2. Outboard turned to STARBOARD

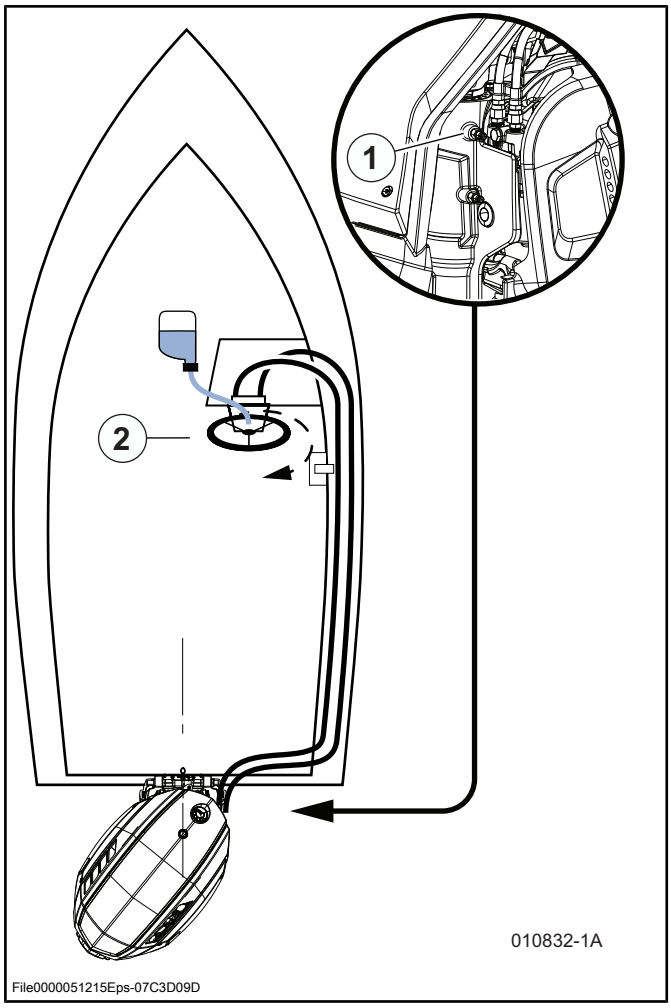
5. Turn the steering wheel counter-clockwise until the outboard is turned fully to PORT and resistance is felt. Be sure to maintain fluid level at the helm/reservoir.



1. Turn the steering wheel counter-clockwise
2. Outboard turned to PORT

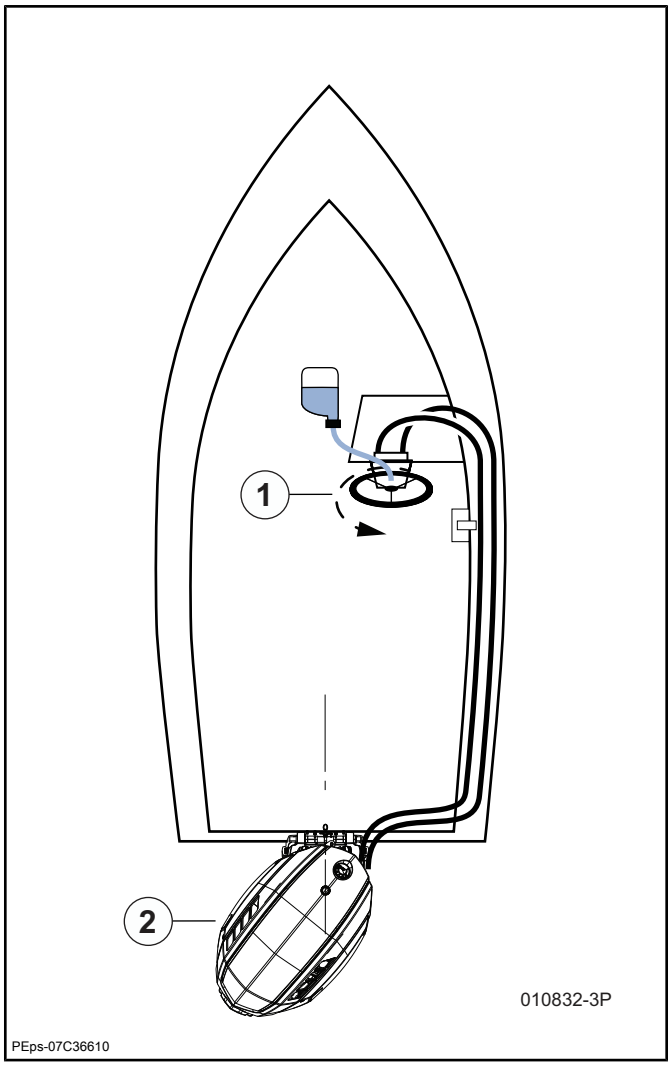
Have an assistant open and close the bleed valves and hold the outboard in position as directed:

6. Attach a length of clear hose to the UPPER bleed valve. Use an appropriate container to catch fluid flowing from the bleed valve.
7. Open the UPPER bleed valve **one–half** turn.
8. **Hold** the outboard in a PORT turn.
9. Then turn the steering wheel clockwise. Continue turning the steering wheel clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve. Be sure to maintain fluid level at the helm/reservoir.



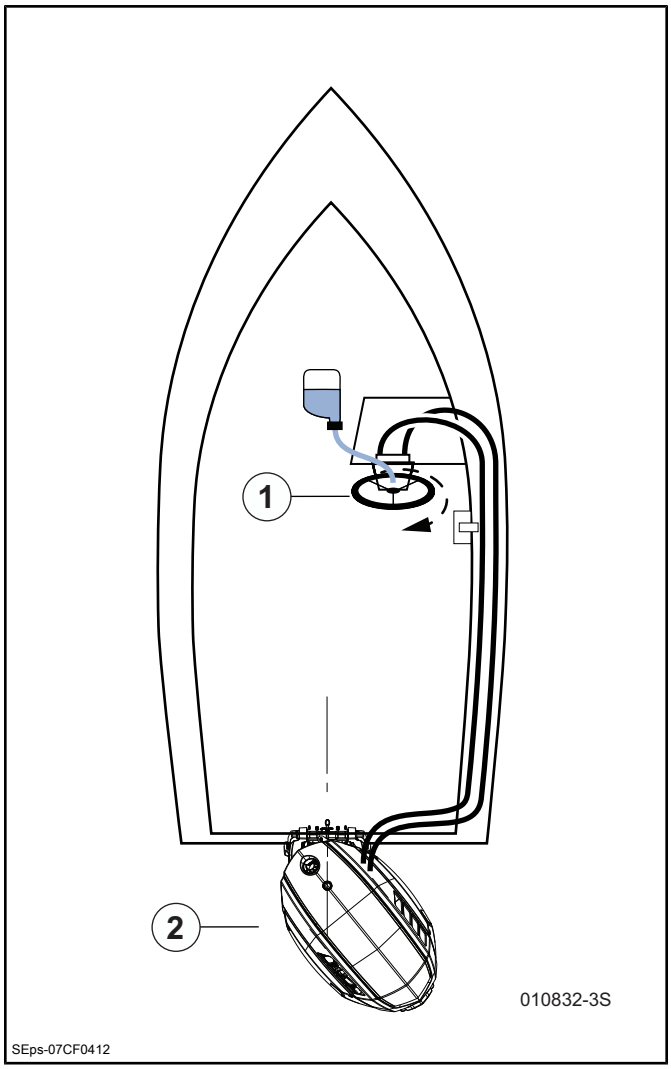
1. UPPER bleed valve
2. Turn the steering wheel clockwise

10. **Hold** the outboard in a PORT turn.
11. Then turn the steering wheel counter– clockwise. Continue turning the steering wheel counter– clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve. Be sure to maintain fluid level at the helm/reservoir.



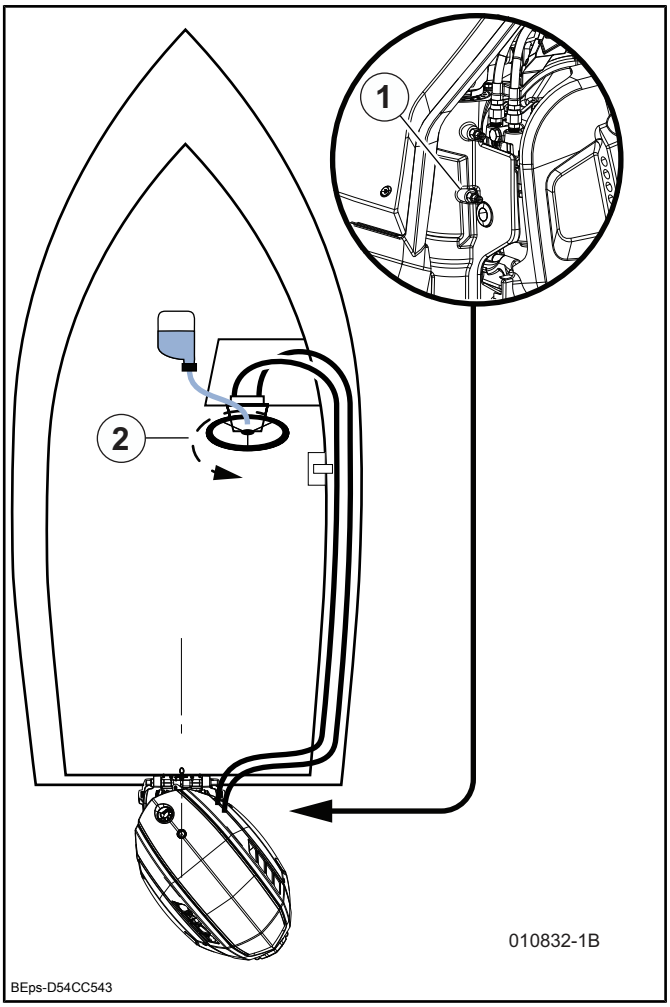
1. Turn the steering wheel counter-clockwise
2. Hold outboard in PORT turn

12. Have the assistant release the outboard. Close the UPPER bleed valve.
13. Turn the steering wheel clockwise until engine is turned fully to STARBOARD and resistance is felt. Be sure to maintain fluid level at the helm/reservoir.



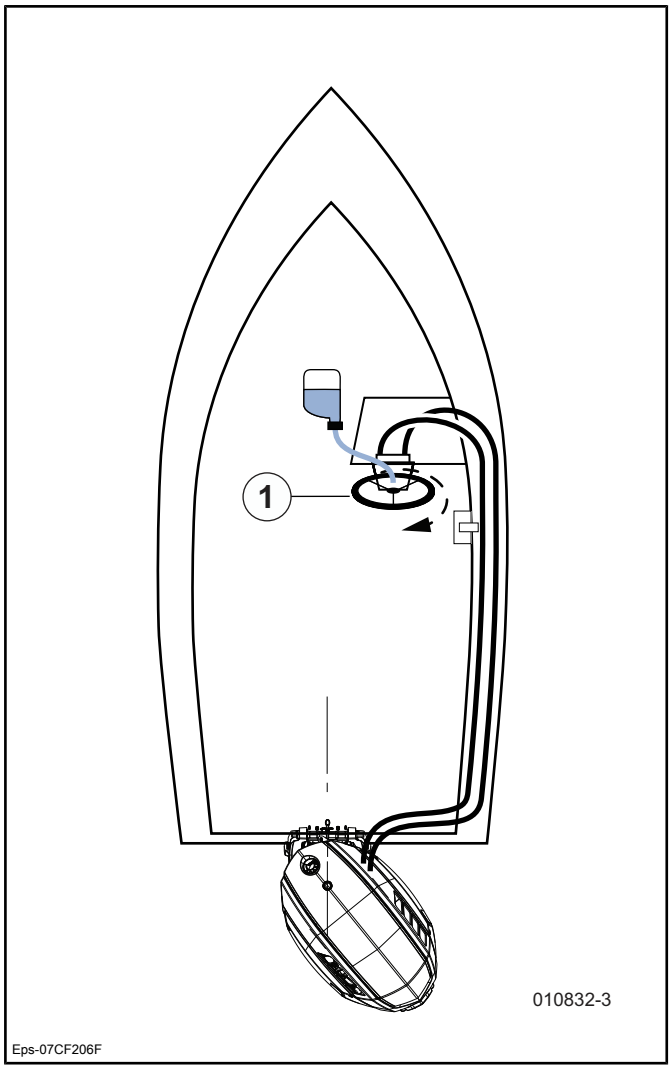
1. Turn the steering wheel clockwise
2. Outboard turned to STARBOARD

14. Attach the length of clear hose to the LOWER bleed valve.
15. Open the LOWER bleed valve **one–half** turn.
16. **Hold** the outboard in a STARBOARD turn.
17. Then turn the steering wheel counter– clockwise. Continue turning the steering wheel counter– clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve. Be sure to maintain fluid level at the helm/reservoir.



1. LOWER bleed valve
2. Turn the steering wheel counter-clockwise

18. **Hold** the outboard in a STARBOARD turn.
19. Then turn the steering wheel clockwise. Continue turning the steering wheel clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve. Be sure to maintain fluid level at the helm/reservoir.



1. Turn the steering wheel clockwise

20. Have the assistant release the outboard. Close the LOWER bleed valve.
21. Tighten both bleed valves to a torque of 84 to 120 in.lb. (9.5 to 13.5 N·m).
22. Remove the filler tube from the helm. Install the fill cap on the helm, tighten securely.
23. Proceed to **Steering System Checks**.

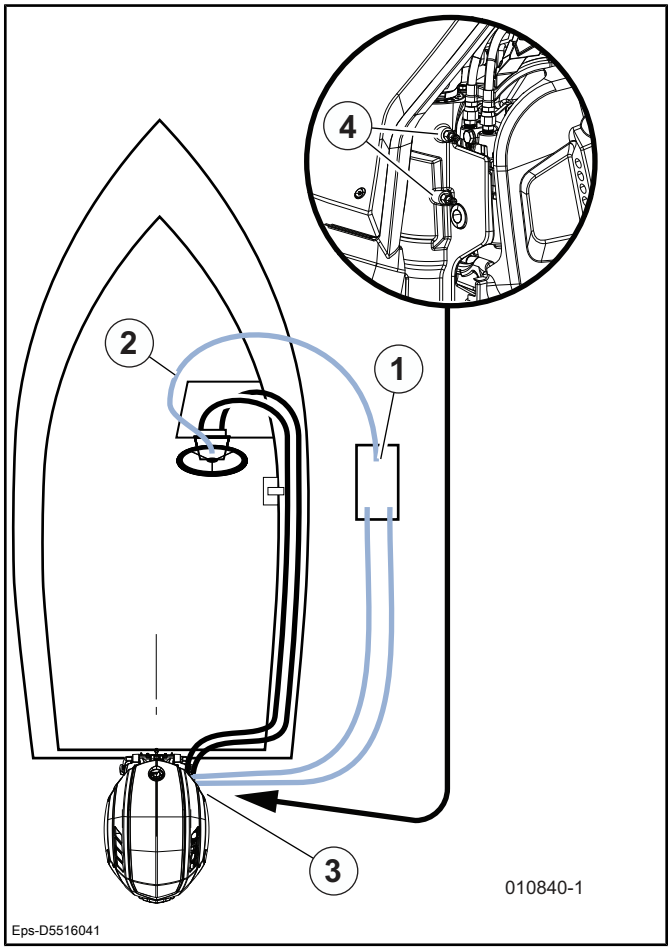
Power Purge Method

A *Teleflex Power Purge* system, P/N 768014, can be used to bleed the steering system. Make sure the purging unit has the correct hydraulic fluid. Purge the steering system manually if the fluid in the purging unit is a non-approved or unknown type.

IMPORTANT: Turn the key switch to the ON position for models with DPS.

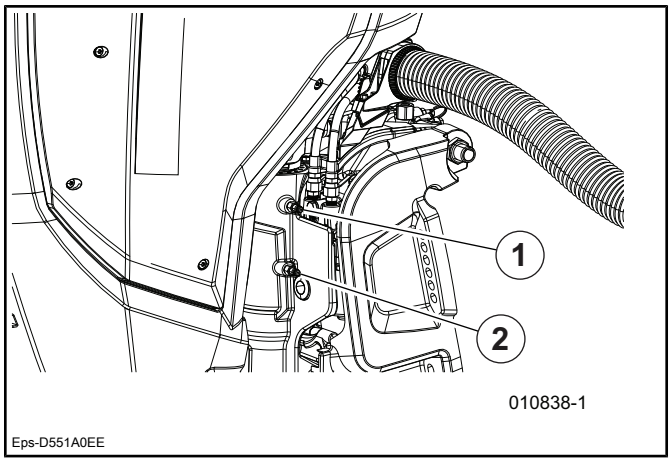
TELEFLEX POWER PURGE JR.

1. Remove the fill cap from the helm. Connect the hydraulic fluid supply line of the purging unit to the helm.
2. Connect the hydraulic fluid return lines of the purging unit to the two bleed valves of the steering system.



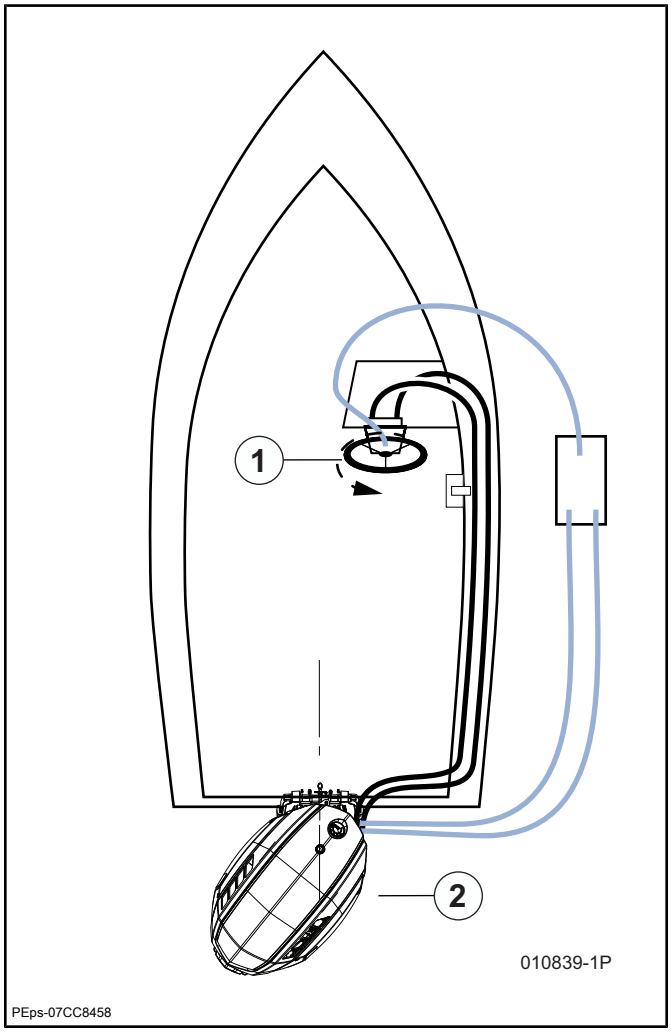
1. Power Purge unit
2. Hydraulic fluid supply lines
3. Hydraulic fluid return lines
4. Bleed valves

3. Loosen both bleed valves **one-half** turn. Then turn the purge unit ON.



1. Upper bleed valve
2. Lower bleed valve

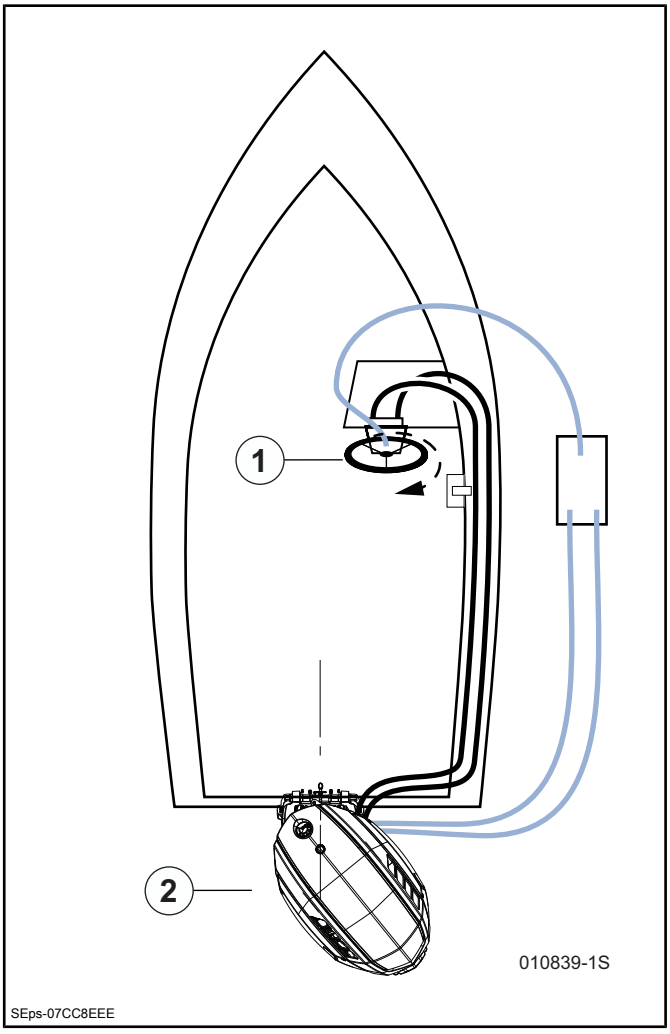
4. After air bubbles are no longer visible, turn the steering wheel counterclockwise until engine is turned fully to PORT and resistance is felt.



1. tTurn the steering wheel counterclockwise
2. Outboard turned to PORT

Have an assistant hold the outboard in position as directed:

5. **Hold** the outboard in a PORT turn.
6. Turn the steering wheel counter– clockwise. Continue turning the steering wheel counter–clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve.
7. Next turn the steering wheel clockwise. – Continue turning the steering wheel clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve.
8. Have the assistant release the outboard. Turn the steering wheel clockwise until engine is turned fully to STARBOARD and resistance is felt.



1. Turn the steering wheel clockwise
2. Outboard turned to STARBOARD

9. **Hold** the outboard in a STARBOARD turn.
10. Turn the steering wheel clockwise. – Continue turning the steering wheel clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve.
11. Next turn the steering wheel counter– clockwise. – Continue turning the steering wheel

counter– clockwise until there are no air bubbles present in the flow of fluid coming out of the bleed valve.
12. Have the assistant release the outboard. Tighten both bleed valves to a torque of 84 to 120 in. lb. (9.5 to 13.5 N·m). Then turn the purge unit OFF.
13. Disconnect the return lines of the power purge from the two bleed valves of the steering system.
14. Disconnect the hydraulic fluid supply line of the power purge from the helm.
15. Install the covers on the bleed valves. Install the fill cap on the helm, tighten securely.
16. Perform **Steering System Checks**.

Steering System Checks

1. Turn steering wheel to PORT. After engine is turned fully to PORT, apply enough force to the steering wheel to exceed the pressure relief valve pressure of the helm.
2. While pressure is maintained on helm, check all PORT lines and fittings for leaks.
3. Turn steering wheel to STARBOARD. After engine is turned fully to STARBOARD, apply enough force to the steering wheel to exceed the pressure relief valve pressure of the helm.
4. While pressure is maintained on helm, check all STARBOARD lines and fittings for leaks.
5. Repair all leaks. Repeat steps 1 through 4 before continuing.
6. Cycle the steering system from full PORT turn to full STARBOARD turn several times. Definite resistance should be felt when the steering wheel is turned full PORT or full STARBOARD.

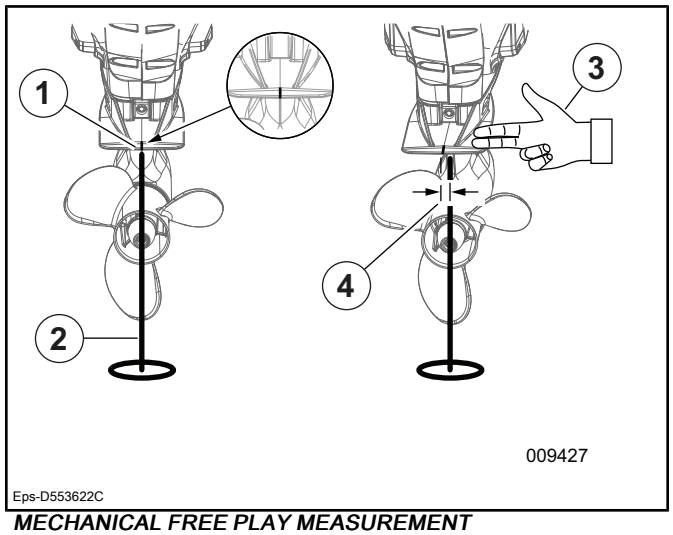
IMPORTANT: If definite resistance is NOT felt, or if steering feels loose or “soft” wait 15 minutes and repeat the bleeding process.

7. Check the fluid level of the helm pump and fill per the manufacturers recommendation.
8. Check mechanical free play.

NOTE: Some free play movement of the steering system is normal.

Check mechanical free play:

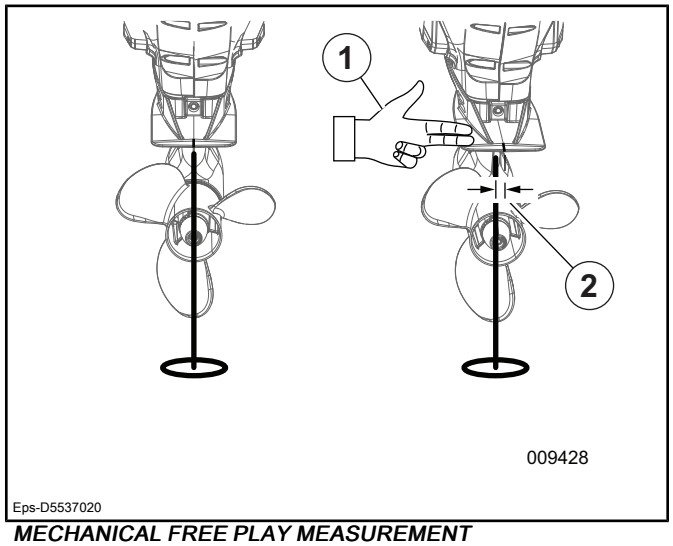
– Make sure the anti-ventilation plate of the gearcase is approximately level.
– Make a mark in the center/rear of the anti-ventilation plate of the gearcase.
– Center a stationary object, such as a length of threaded rod attached to a plate, behind the mark on the gearcase to serve as a reference point.
– Use two fingers to push the gearcase to port.
– Measure and record the distance between the mark and the reference point.



MECHANICAL FREE PLAY MEASUREMENT

1. Mark
2. Reference point object
3. Push against gearcase
4. Measurement

– Use two fingers to push the gearcase to starboard.



MECHANICAL FREE PLAY MEASUREMENT

1. Push against gearcase
2. Measurement

– Measure and record the distance between the mark and the reference point.

Add the measurements. The result should not exceed approximately 0.59 in. (15 mm).

If the result exceeds this dimension, additional bleeding may be required. Push the gearcase to port, until the steering mechanism bumps the mechanical stop. Then push steadily with increasing force. Repeat to starboard. Definite resistance

should be felt in both directions. If after bumping the mechanical stop the gearcase continues to move in the direction it is being pushed, or it feels loose or “soft” repeat the bleeding process.

Operational Checks

⚠ DANGER

DO NOT run the engine indoors or without adequate ventilation or permit exhaust fumes to accumulate in confined areas. Engine exhaust contains carbon monoxide which, if inhaled, can cause serious brain damage or death.

⚠ WARNING

Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off.

⚠ CAUTION

DO NOT run outboard without a water supply to the outboard’s cooling system. Cooling system and/or powerhead damage could occur.

Start-In-Gear Prevention

⚠ WARNING

Make certain that the starter will not operate when the outboard is in gear. The start-in-gear prevention feature is required by the United States Coast Guard to help prevent personal injuries.

Start outboard and shift to FORWARD.

Turn outboard OFF while control is in FORWARD.

Try to restart the outboard. Outboard should not start.

Shift back to NEUTRAL and restart outboard.

Shift to REVERSE. Turn outboard OFF while control is in REVERSE.

Try to restart the outboard. Outboard should not start.

Remote Control Operation

Make sure that control can be easily moved into all gear and throttle settings.

Emergency Stop / Key Switch

Check emergency stop function. With outboard running at IDLE, pull safety lanyard from emergency stop switch. Outboard must stop immediately. If equipped, be sure to check emergency stop function of second station.

Digital Displays and Gauges

Complete basic set up of digital display or gauges. Configure engine and fuel tank, set fuel tank capacity etc. Refer to User’s Guide.

Tachometer Pulse Setting (SystemCheck™)

Confirm accuracy of tachometer reading.

– Adjust dial on back of tachometer to required setting (the outboard should not be running).

Outboard Model	Tachometer Setting
15–300 HP	6 Pulse or 12 Pole

Engine Monitoring System

Attach emergency stop lanyard.

Turn key switch to the ON position.

Evinrude Touch-Screen Display

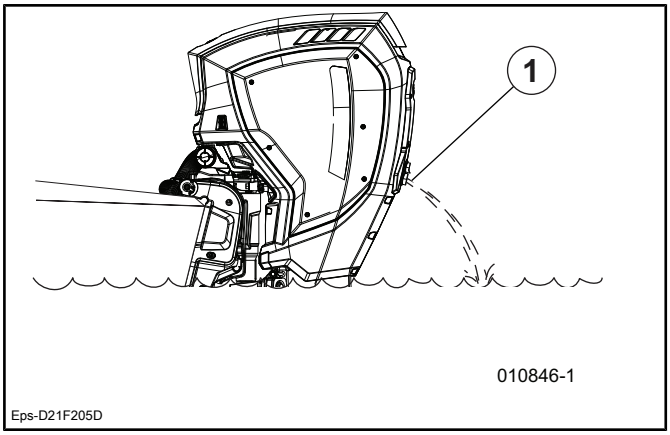
– The touch screen system will run a start up sequence and then display the *Evinrude* welcome page. When the start up sequence is complete, the default digital display will appear

SystemCheck

– The *SystemCheck* monitor, if equipped with an optional warning horn, sounds a beep. The *SystemCheck* gauges self-test by turning the indicator lights on simultaneously, then off in sequence.

Water Pump Overboard Indicator

A steady stream of water should flow from the overboard indicator.



1. Water pump overboard indicator

Operating Temperature

An outboard run at idle speed should achieve a temperature based on the engine's thermostatic control. In general, the powerhead temperature should reach at least 104° F (40° C) after five minutes of idling. Check that the powerhead reaches idle temperature.

Leaks

Perform running checks as follows:

- Start outboard
- Inspect all fuel hoses and connections
- Inspect all oil hoses and connections
- Inspect all cooling water hoses and connections
- Repair any leaks or improperly routed hoses immediately

Idle Speed

Make sure the outboard idles within the specified idle RPM range. If the outboard is run on a flushing device, the idle speed and quality may not be representative of actual in water use.

Break-In

Evinrude E-TEC outboards require no break in. When the outboard is delivered, refer the customer to the Oiling System information in the **Operator's Guide**.

Adjustments

An in the water test is required to make sure the outboard (s) and boat are rigged correctly, propeller selection is correct, and that all accessories function properly.

Pay special attention to the following, especially if the boat is re-powered with new outboard(s):

- Engine mounting height
- Jack plate adjustment
- Correct propeller selection and WOT RPM
- Fuel system vacuum
- Engine water pressure/optional water screens

Make all needed adjustments or repairs and retest before delivery.

When ready for delivery, give all instruction sheets, operating instructions and user guides provided with accessories to the owner. Advise the owner of any special operation or maintenance information contained in the instructions.

IMPORTANT: Complete the Predelivery Checklist and obtain owner's signature at the time of delivery. The Predelivery Checklist must be kept on file for seven years.

Engine Mounting Height and Jack Plate Adjustment

Goals include:

- Engine RPM within the full throttle operating range
- Best acceleration and top speed
- No excessive ventilation while boat is coming onto plane.

Start with the engine lower on the transom. Make a test run, taking note of engine RPM, water pressure, trim level and boat speed.

Raise the engine or jack plate and repeat the process until the best acceleration and boat speed are achieved.

Fuel System Vacuum

Test fuel system vacuum. Refer to **Fuel Lift Pump Vacuum Test.** The maximum inlet fuel vacuum should not exceed 4 in. Hg. (13.5 kPa) at the inlet to the fuel lift pump under any operating conditions (IDLE to WOT).

A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed.

Engine Water Pressure

Check engine water pressure. Confirm adequate water pressure at all engine speeds and in turns.

If water pressure falls below acceptable levels, adjust outboard alignment (multiple engine installations).

Trim and Tilt

The trim and tilt functions of *Evinrude E-TEC G2* outboards are controlled by the engine *EMM*.

IMPORTANT: Activating any trim button while the key switch is in the OFF position will briefly turn on the system. This will cause the electric fuel pump to run and the remote control and any displays or gauges to turn on. There will be a short delay before the trim system operates. This is normal. The system will turn off after a few seconds of non-use.

Trim Limit Setting

⚠ WARNING

If the outboard does not clear all boat parts when tilted fully or turned side to side, safety related parts could be damaged in the course of such outboard movement. Injuries could result from loss of boat control.

⚠ WARNING

Adjusting the tilt limit will NOT prevent the outboard from tilting fully and contacting the motor well if the gearcase hits an object at high speed. Such contact could damage the outboard and boat and injure boat occupants.

NOTICE

The tilt limit setting will not prevent the outboard from overriding the adjustment if the outboard is tilted manually.

Check the tilt limit on all new outboard installations.

Check the clearance between outboard(s) and the boat's motor well and transom area. Tilt outboard (s) to highest point of clearance and turn the steering system lock to lock.

If the outboard contacts the boat's motor well when fully tilted, set the tilt limit to reduce full-tilt position.

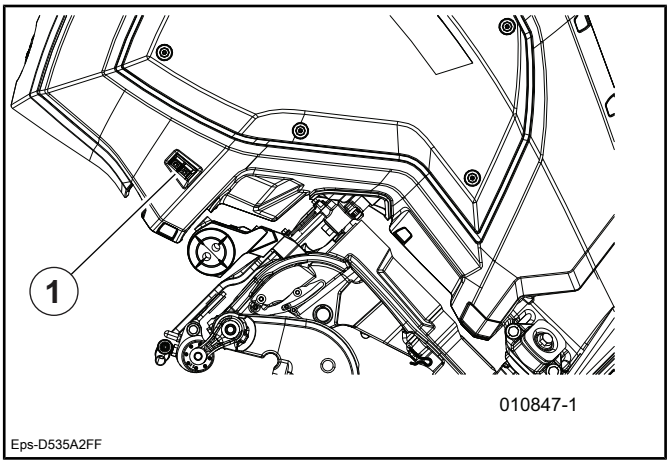
To prevent damage to equipment, provide additional motor well clearance when needed. Consider either changing the outboard mounting position or modifying the boat if the possibility for interference and damage exists.

Manual Method

You MUST use the trim switch on the starboard engine cover to set the tilt limit with this method.

Tilt the engine up to the desired maximum tilt position.

Then, simultaneously press and hold for at least three seconds, both the up and down trim buttons.



1. Press and hold for at least three seconds, both the up and down trim buttons

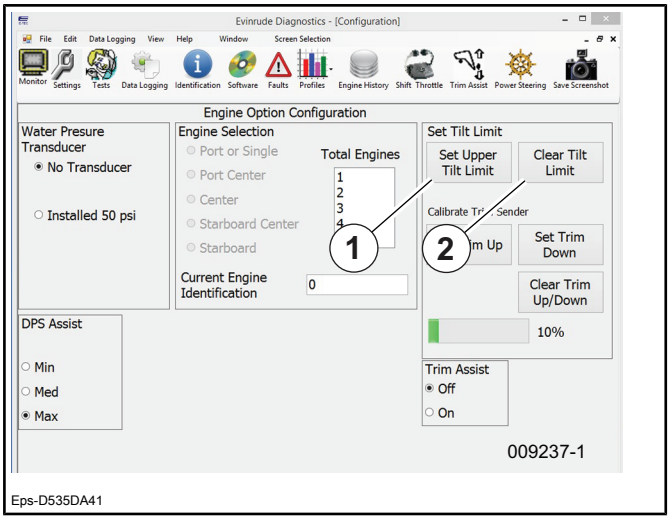
Check your adjustment — tilt the outboard fully and adjust further, if necessary. Check after each adjustment.

To change or clear this setting, tilt the engine to the full down position.

Then, simultaneously press and hold for at least three seconds, both the up and down trim buttons.

Diagnostic Software Method

Use *Evinrude Diagnostic* software v 6.4 or higher to limit maximum tilt-up.



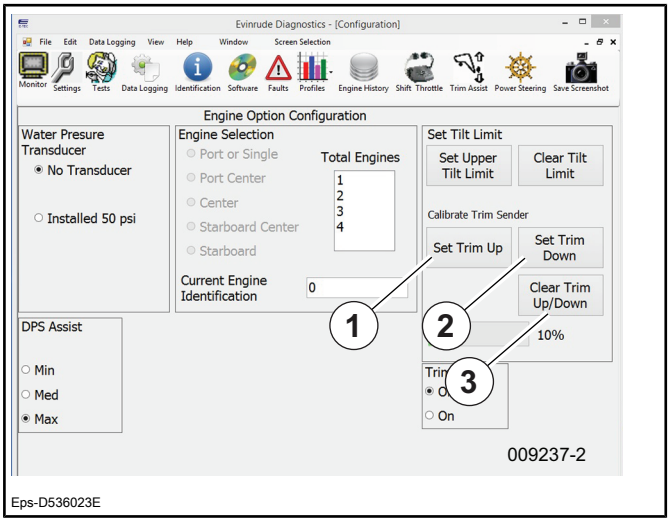
1. *Set Tilt Limit*

Check your adjustment — tilt the outboard fully and adjust further, if necessary. Check after each adjustment.

Repeat this procedure until the tilt limit stops the outboard's upward travel before it contacts the motor well.

Trim Gauge Calibration

Observe the trim gauge. If needed, use *Evinrude Diagnostics* software v 6.4 or higher to calibrate the upper and lower trim range of the gauge.



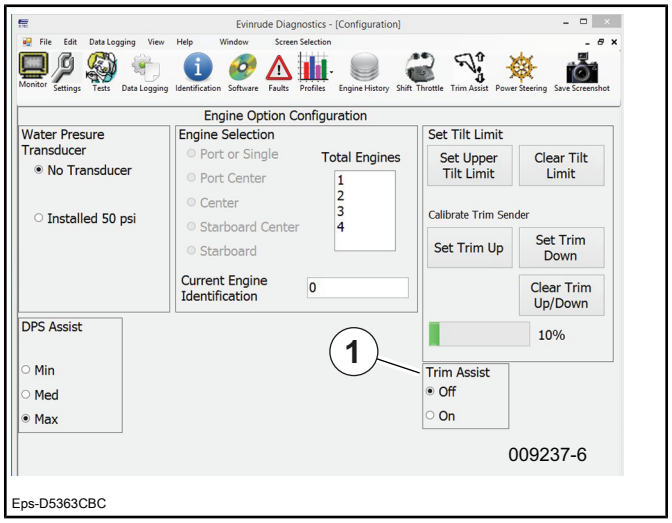
1. *Set Upper Trim Limit*
2. *Set Lower Trim Limit*
3. *Clear Trim Limit*

iTrim

Operation

Evinrude E-TEC G2 outboards are equipped with *iTrim*, an automatic trim-assist feature. By default, this feature is disabled from the factory.

Use the *Evinrude ICON-Touch* or *Nuatilus CS* digital display to enable *iTrim*. If the boat is not equipped with a digital display, use the *Configuration* screen of *Evinrude Diagnostics* software v 6.4 or higher to enable trim assist.



1. *Trim Assist*

To activate the *i-Trim:*

– the key switch must be in the ON position
– use the trim/tilt switch to trim the engine to the full DOWN position.

During operation, the outboard will automatically trim up or down to an acceptable trim angle based on pre-programmed parameters.

Use the trim/tilt switch on the control lever to fine tune to an optimum trim angle.

IMPORTANT: Use of the trim/tilt switch to manually adjust the outboard trim angle will temporarily deactivate *i-Trim*.

To reactivate *i-Trim*:

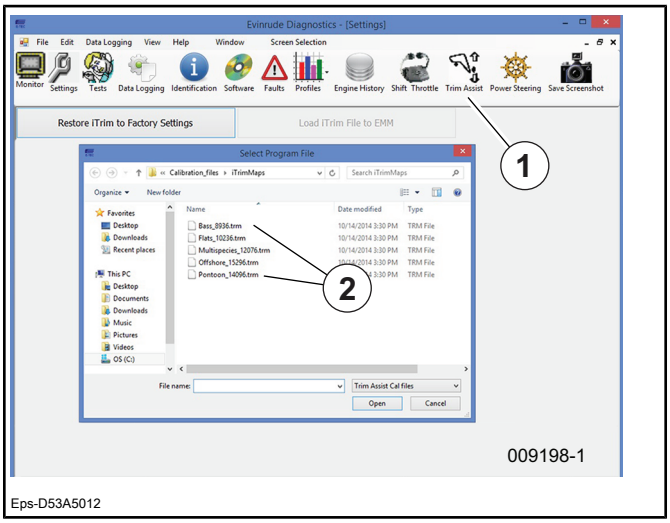
– use the trim/tilt switch to trim the engine to the full down position
– bring the engine to idle speed

Custom *iTrim* Settings

Custom *iTrim* settings are available for certain applications where the factory default setting is not optimized to the application.

Use *Evinrude Diagnostics* software v 6.4 or higher to select an available custom *iTrim* setting. From the Trim Assist menu, select “Load iTrim File to EMM”.From the pop-up window, select the desired

".trm" file, then select the "Open" button to load the file.



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1. *Trim Assist button*
2. *.trm files*

Dynamic Power Steering

Evinrude E-TEC G2 models equipped with Dynamic Power Steering (DPS) offer three power steering assist levels.

Power Steering Assist Levels

All power steering assist levels provide the same rate of assist at engine speeds below 4500 RPM.

As engine speed increases above 4500 RPM, assist levels progressively decrease.

⚠ WARNING

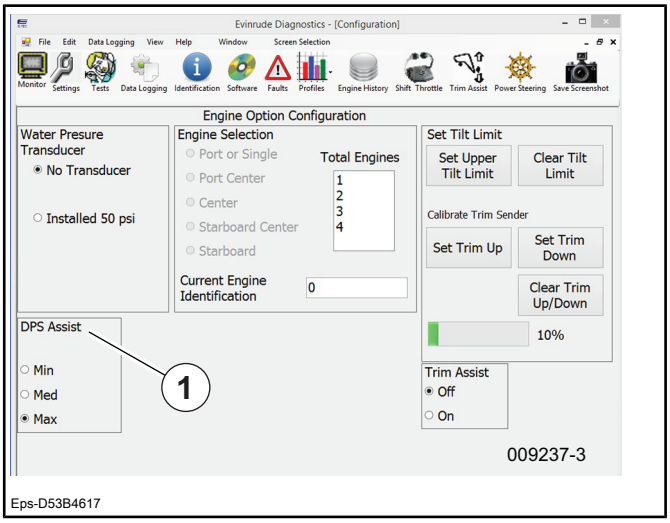
Selection of power steering assist level is operator preference.
Be aware that changing the power steering assist level can affect boat handling.
After changing the level of power steering assist, operate the boat with care to become familiar with any changes in boat handling characteristics.

IMPORTANT: At engine speeds below 4500 RPM, ALL power steering assist levels provide the same rate of assist.

The factory default assist level is "Minimum". Use the *Evinrude ICON-Touch* or *Nautilus CS* digital display to change the power steering assist level.

Refer to the *Evinrude ICON-Touch* or *Nautilus CS* user's guide.

If the boat is not equipped with a digital display, use the *Configuration* screen of *Evinrude Diagnostics software* v 6.4 or higher to change the power steering assist level.



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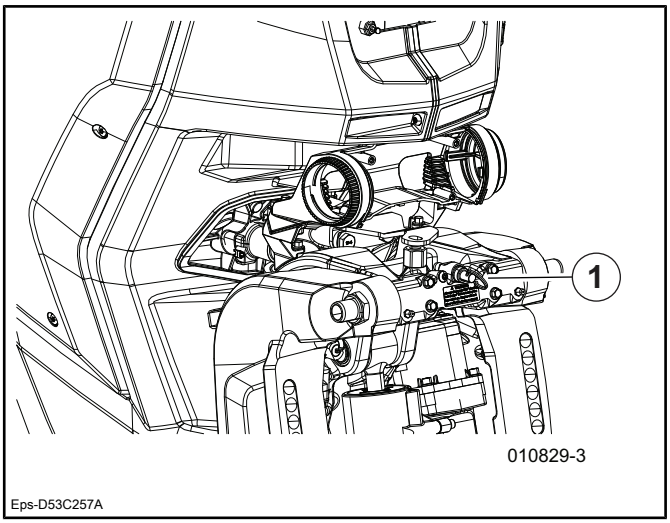
1. *DPS Assist*

Steering Lock Device

A steering lock device is provided with DPS models. To prevent the outboard from turning during transport:

– Remove the pin from its storage location above the tilt tube.



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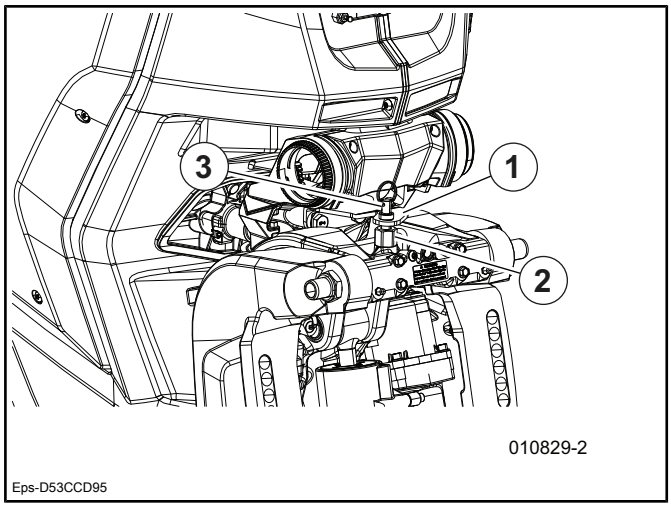
1. *Pin*

– Center the steering arm bracket over the bushing.
– Install the pin through the steering arm bracket into the bushing.



1. Steering arm bracket.
2. Bushing
3. Pin

Dual Outboard Alignment

Dual outboards must be connected with a tie bar and adjusted to align the outboards for correct water flow to the gearcases and propellers.

Incorrect outboard alignment could cause one or more of the following:

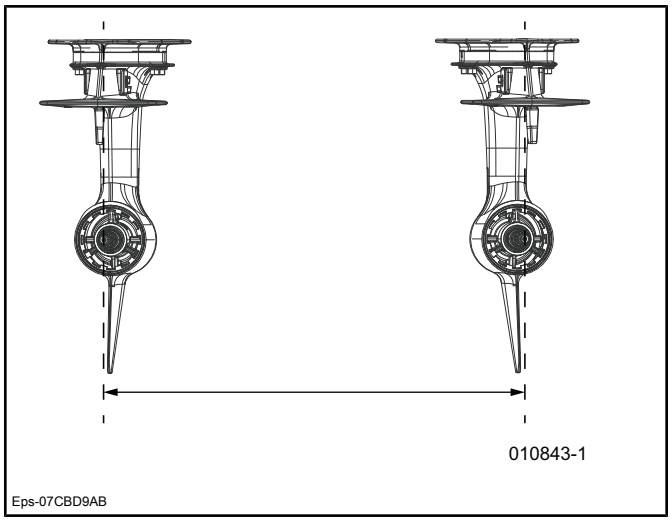
– Propeller ventilation
– Reduction of top speed
– Improper boat tracking
– Engine overheat and powerhead damage

Follow the instructions provided by the tie-bar manufacturer for tie bar installation and adjustment.

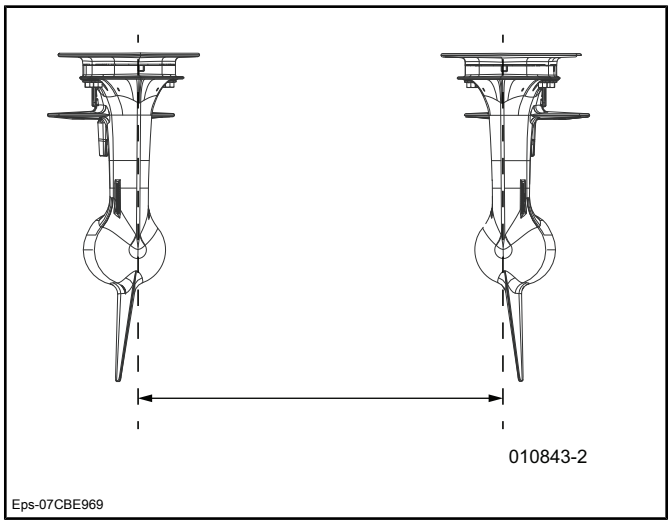
Measure Alignment

The “toe-in” (gearcase leading edges closer together than propeller shaft centers) or “toe-out” (gearcase leading edges farther apart than propeller shaft centers) is determined as follows:

– Position outboards straight with the anti-ventilation plates parallel with the bottom of the boat.
– Measure between propeller shaft centers



– Measure between leading edges of gearcase.



Alignment Adjustment

Various boat/motor combinations respond differently to dual-outboard alignments. Each application must be thoroughly tested until the ideal combination of performance, steering, and cooling is found.

A common practice is to set-up the outboards parallel, or with a small amount of “toe-out,” and adjust inward until best results are achieved.

– A typical set-up, with outboards mounted directly on the transom, often runs best with a slight amount of “toe-in.”
– Outboards mounted behind the transom on motor brackets usually require parallel alignment or “toe-out.”

Adjust the outboard alignments by adjusting tie bar. Follow the tie bar manufacturer’s adjustment procedures.

Check steering operation. Make sure that the steering system operates properly at various trim angles.

Confirm Alignment

To confirm proper alignment, perform the following steps:

- Water test the boat
- Monitor the water pressure for both outboards
- Run the boat at various trim angles
- Perform steering maneuvers and vary the throttle settings
- Monitor boat and outboard performance

A sudden loss of water pressure or excessive propeller ventilation on one or both outboards may indicate a misalignment of the gearcases. Reset the outboard alignment and retest.

Propellers

Propeller Selection

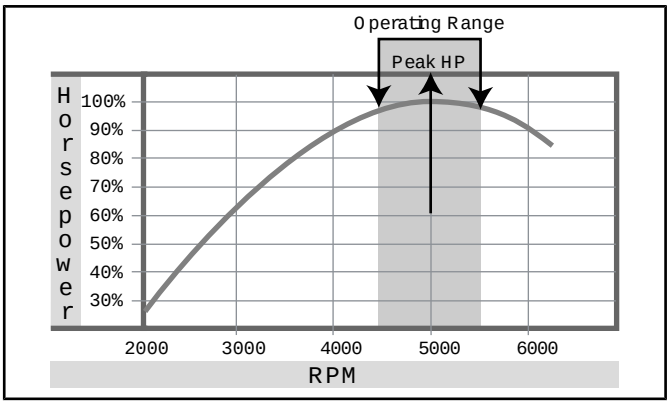
⚠ CAUTION

Selection of the wrong propeller could reduce engine service life, affect boat performance, or cause serious damage to the powerhead.

The RX3 and RX4 propellers are recommended specifically for *Evinrude E-TEC G2* Inline 3–cylinder outboards.

Water testing with various propeller designs and sizes is the best method of propeller selection.

The correct propeller, under normal load conditions, will allow the engine to run near the midpoint of the RPM operating range at full throttle. Refer to **Service Specifications** for RPM range.

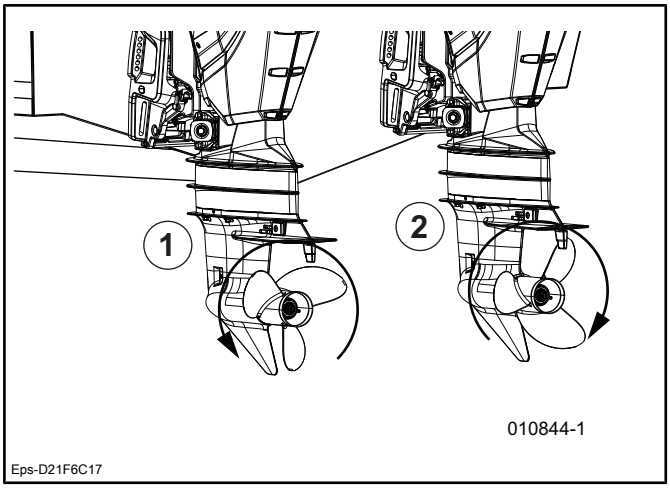


NOTICE

If the propeller blades have too much pitch, the engine will operate below its normal range at full throttle. Power will be lost, and powerhead damage could occur. If the propeller blades have too little pitch, the engine will operate above its normal range and damage from over-speeding could occur.

When selecting a propeller, consider the following:

1. Use an accurate tachometer to determine the engine's full-throttle RPM.
2. The outboard should be trimmed for top speed.
3. Select a propeller that suits the customer's application and allows the engine to run near the midpoint of the full-throttle operating range when the boat has a normal load.
4. Occasionally, one propeller will not cover a wide range of boat applications — water skiing to high speed performance boating. In such cases, it might be necessary to have a propeller for each situation.
5. Refer to the *Evinrude Genuine Parts and Accessories Catalog* for propeller styles and sizes.
6. Right-hand propellers are considered standard rotation propellers. When propelling a boat forward, the propeller rotates in a right-hand (clockwise) direction as viewed from the rear.
7. Left-hand propellers are considered counter-rotation propellers. When propelling a boat forward, the propeller rotates in a left-hand (counterclockwise) direction as viewed from the rear.



1. *Left-hand rotation (counterclockwise)*
2. *Right-hand rotation (clockwise)*

⚠ WARNING

For multiple outboard installations always check to be sure propellers are installed on the correct engines before aggressively operating the boat.

Propeller Hardware Installation

⚠ WARNING

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

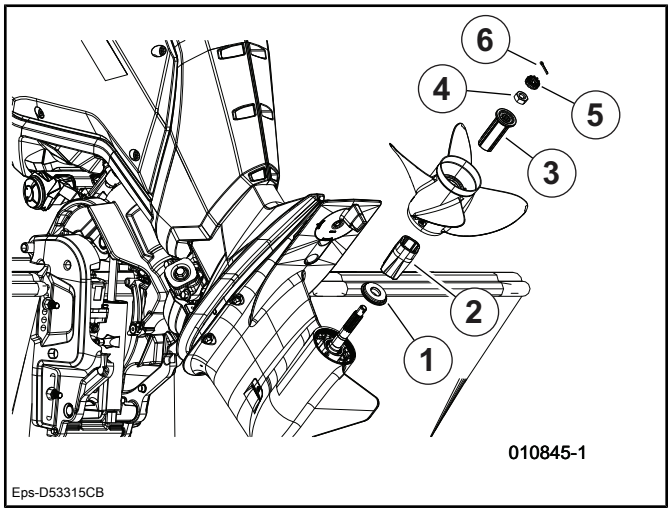
IMPORTANT: *Evinrude E-TEC G2* outboards REQUIRE Propeller Hub Kit, P/N 5010529, and Nut and Keeper Assembly, P/N 5010505.

1. Apply *Triple Guard* grease to the entire propeller shaft before installing the propeller.

Required Chemical
Triple Guard Grease P/N 508298

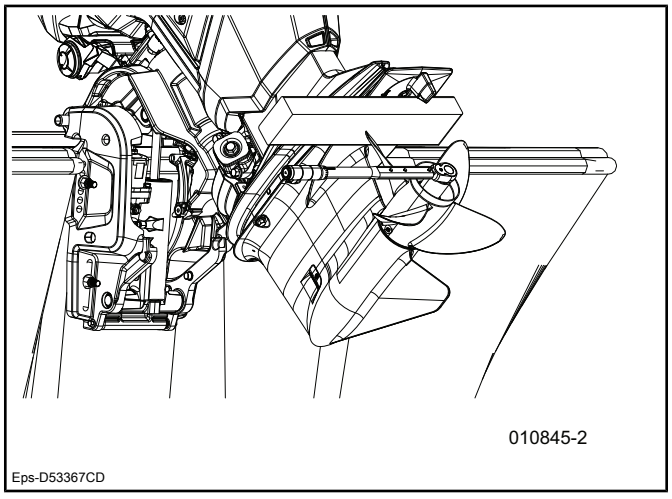
Required Tools
Propeller Hub Kit P/N 5010529
Nut and Keeper Assembly P/N 5010505

2. Install thrust bushing onto propeller shaft with taper of bushing matching taper of shaft.
3. Install the torsion bushing into the propeller.
4. Install the bushing and sleeve into the propeller.
5. Align splines of the sleeve and propeller shaft. Push propeller until seated on the thrust bushing.
6. Install the propeller nut.



1. *Thrust bushing*
2. *Torsion bushing*
3. *Bushing and sleeve*
4. *Propeller nut*
5. *Keeper*
6. *Cotter pin*

7. Wedge a block of wood between propeller blade and the anti-ventilation plate.



8. Tighten the propeller nut to a torque of 70 to 80 ft. lbs. (95 to 109 N·m).
9. Install the keeper, then install a new cotter pin.

IMPORTANT: After installation, make sure outboard is in NEUTRAL and carefully spin the propeller. The propeller must turn freely without binding and should not spin off center. If the propeller binds, check for the correct thrust washer, P/N 128805, which is included with Propeller Hub Kit, P/N 5010529. If propeller appears to wobble, check for possible bent propeller shaft.

Submerged Engines

Once an outboard has been submerged it must be serviced within three (3) hours of recovery. Immediate service can minimize the corrosive affect that air has on the polished surfaces of the crankshaft, connecting rods, and internal powerhead bearings.

IMPORTANT: If outboard cannot be started or serviced immediately, it should be resubmerged in fresh water to avoid exposure to the atmosphere.

Engine Submerged (Not Running)

Disconnect the battery cables at the battery.

Rinse powerhead with clean water.

Remove spark plug leads and spark plugs.

Place outboard in horizontal position (cylinder heads down). Slowly rotate flywheel in a clockwise rotation to work all water out of powerhead.

IMPORTANT: If sand or silt may have entered the outboard, DO NOT attempt to start it. Disassemble and clean.

Disassemble all electrical connectors. Clean connectors and terminals, and treat with water displacing electrical spray. Apply *Dielectric* Grease, P/N 503243, to terminals prior to reassembly. Coat all exposed solenoid terminals and engine grounds with *Black Neoprene Dip*.

Clean and inspect all electrical components. Replace damaged or corroded components prior to returning the outboard to service. Electric starters should be disassembled, cleaned, flushed with clean water, and treated with water displacing electrical spray prior to reassembly.

Disconnect fuel supply hose from outboard. Drain and clean all fuel hoses, filters, and fuel tanks.

Disconnect oil supply hose and oil return hose from outboard. Drain and clean all oil hoses, filters, and oil tank assemblies.

Refill fuel tank with fresh fuel and oil tank with recommended oil.

Prime oil system and fuel system. Refer **toFuel System Priming** and **Oil Supply Priming.** Make sure all oil injection hoses are clean and filled with oil.

Make sure high pressure fuel system does not contain water. Flush as needed.

Inject a small amount of outboard lubricant into spark plug holes and install new spark plugs. Refer to **Spark Plug Installation**.

Reinstall all removed or disconnected parts.

Use *Evinrude Diagnostics* software to:

- Start break-in oiling
- Check fuel pump operation
- Check injector operation (fuel and oil)
- Check timing (once outboard is running at full operating temperature)

Run outboard below 1500 RPM for one-half hour.

Engine Submerged (Running)

Follow the same procedures as **Engine Submerged (Not Running).** However, if there is any binding when the flywheel is rotated, it may indicate a bent connecting rod and no attempt should be made to start the outboard. Powerhead must be disassembled and serviced immediately.

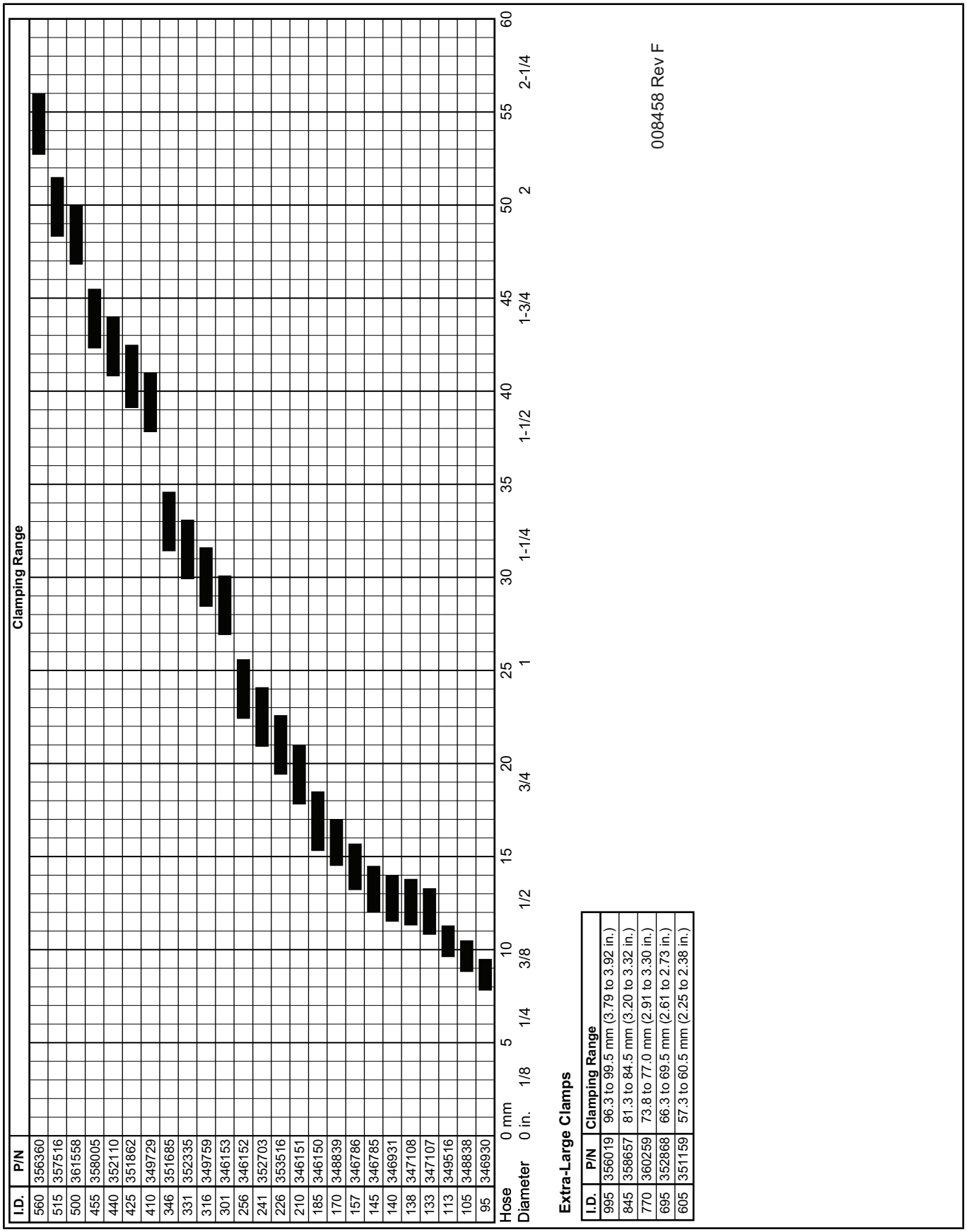
Engine Submerged (In Salt Water)

Follow the same procedures used for **Engine Submerged (Not Running)** and **Engine Submerged (Running)**. Disassemble and clean outboards that have been submerged in salt water for prolonged periods of time. Clean or replace electrical components as necessary.

Prolonged Submersion (Fresh or Salt Water)

Outboards that have been dropped overboard and not recovered immediately, must be serviced within three hours of recovery. Follow the same procedures used for **Engine Submerged (Not Running)** and **Engine Submerged (Running)**.

Oetiker Clamp Chart



Extra-Large Clamps

I.D.	P/N	Clamping Range
995	356019	96.3 to 99.5 mm (3.79 to 3.92 in.)
845	358657	81.3 to 84.5 mm (3.20 to 3.32 in.)
770	360259	73.8 to 77.0 mm (2.91 to 3.30 in.)
695	352868	66.3 to 69.5 mm (2.61 to 2.73 in.)
605	351159	57.3 to 60.5 mm (2.25 to 2.38 in.)

Notes

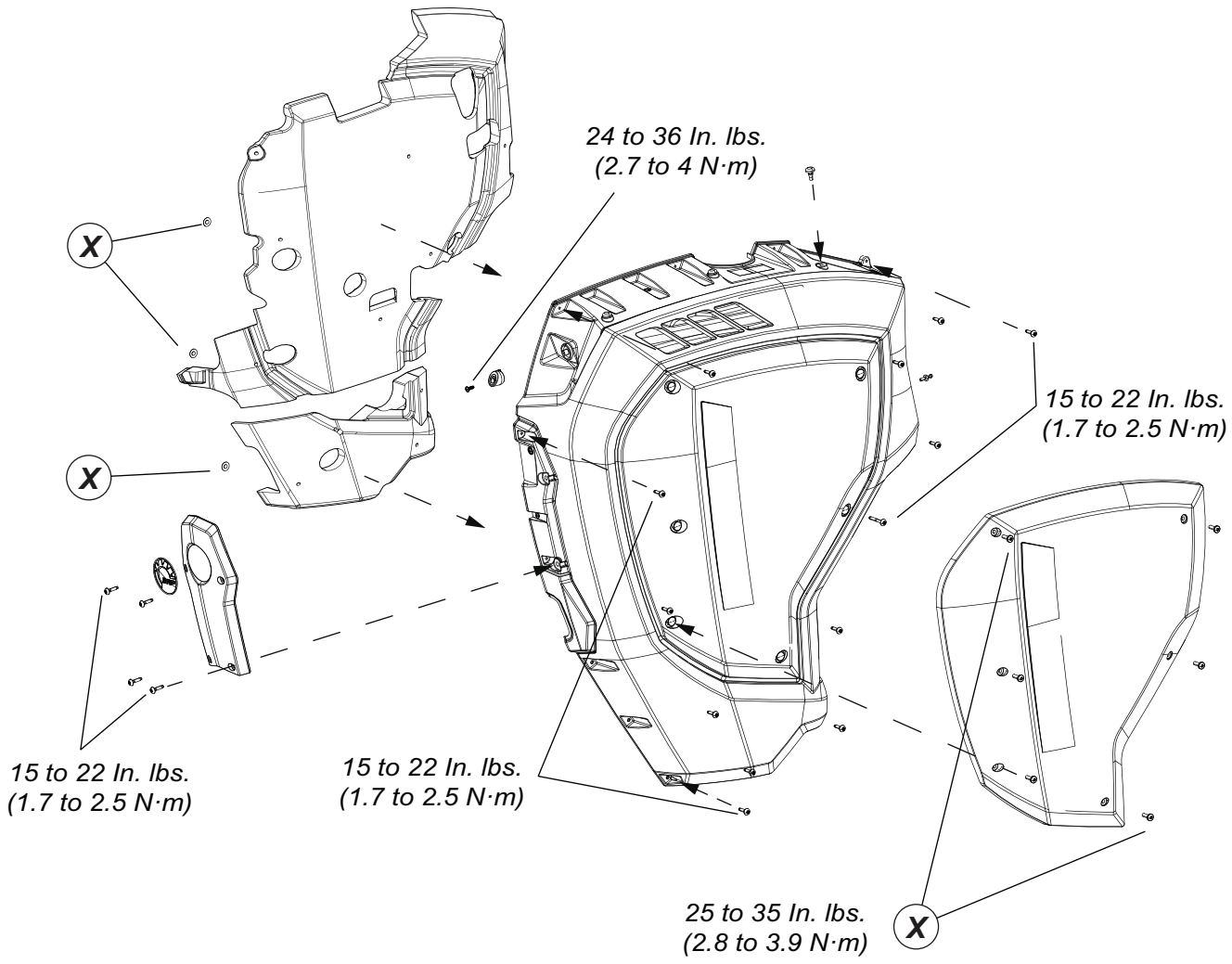
Technician's Notes

Related Documents

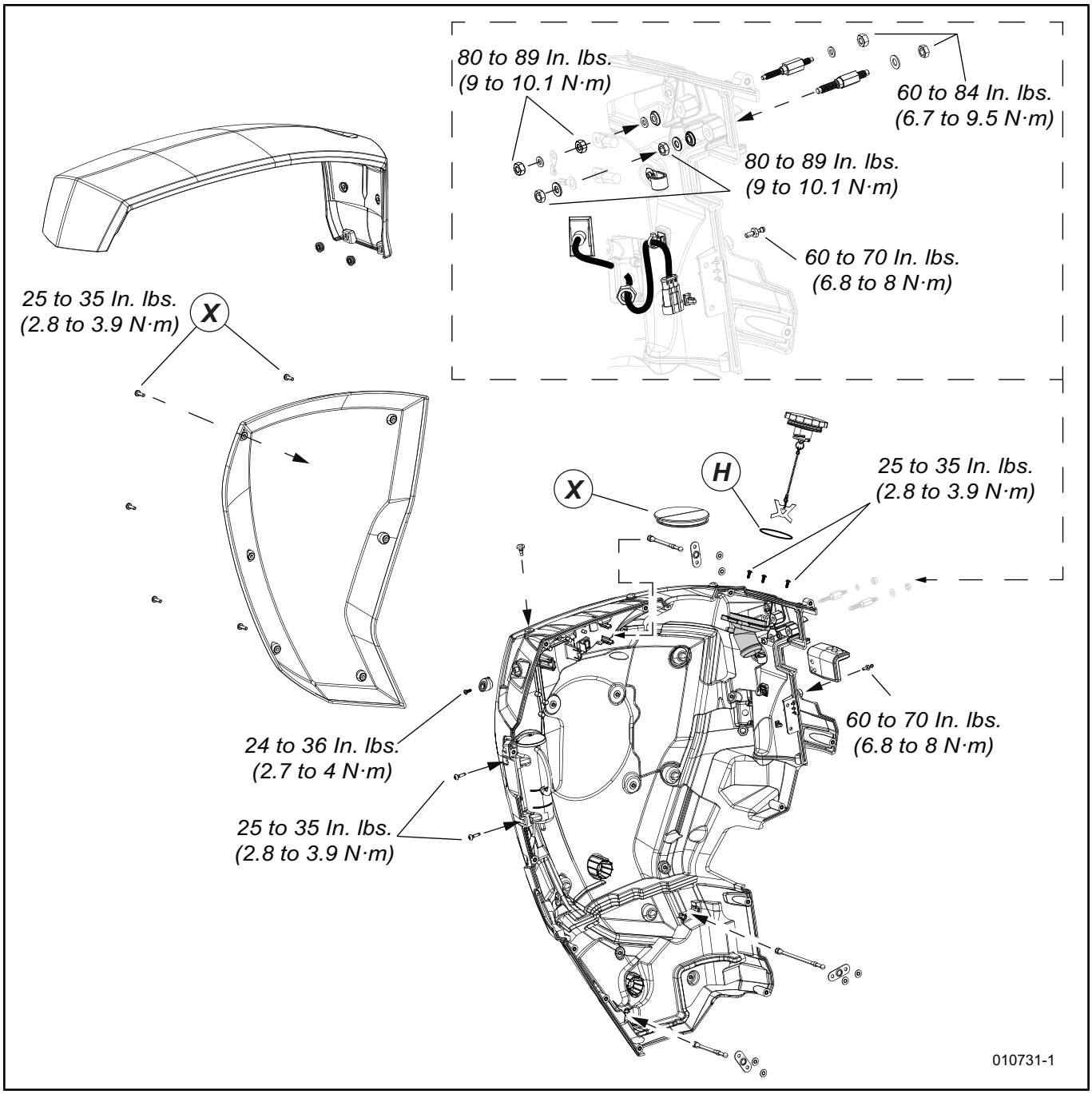
Bulletins	
Instruction Sheets	
Other	

Engine Cover and Frame Service

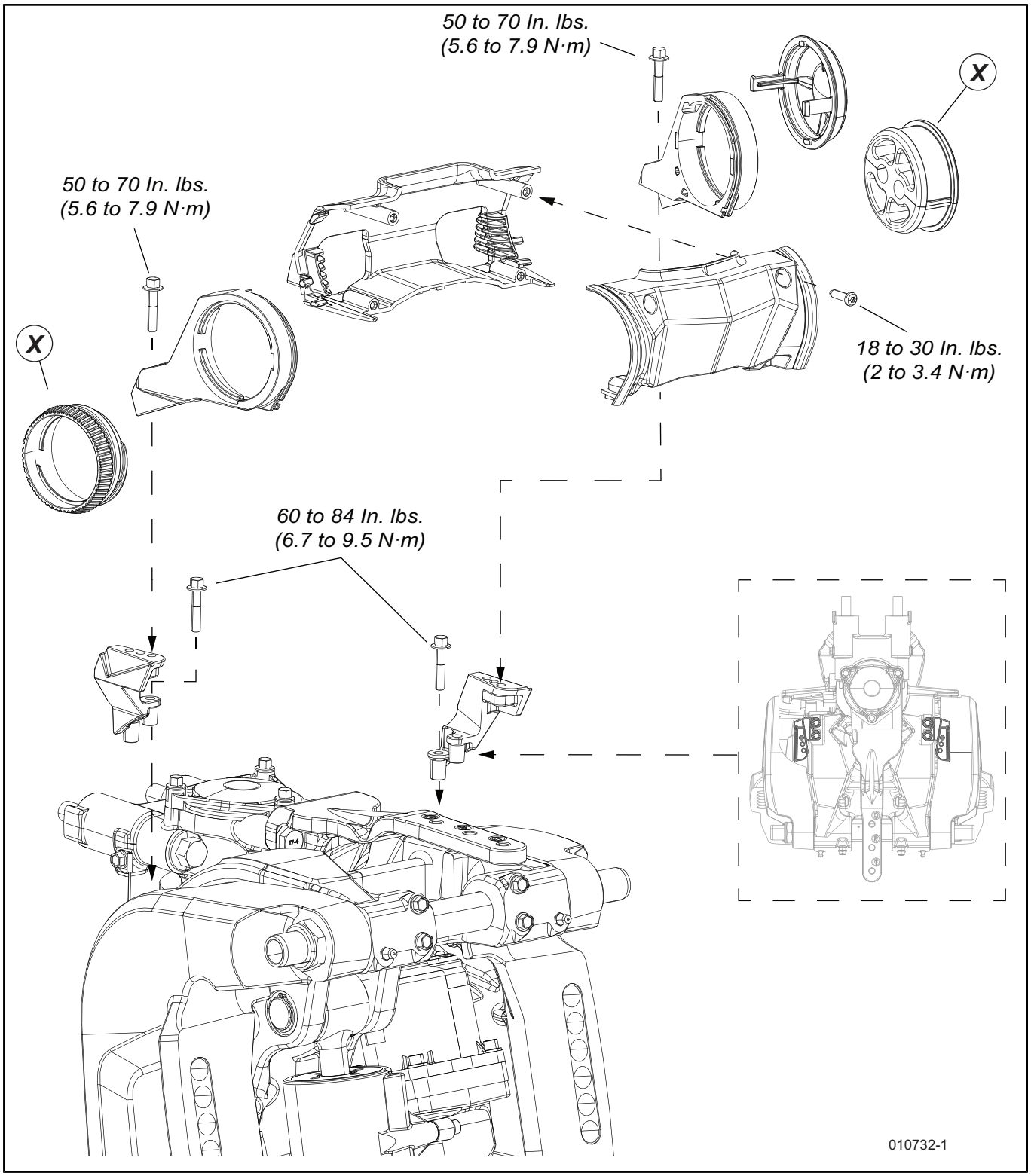
Service Charts: Covers and Frames



H	Outboard Lubricant
X	See Service Manual Procedure



H	Outboard Lubricant
X	See Service Manual Procedure



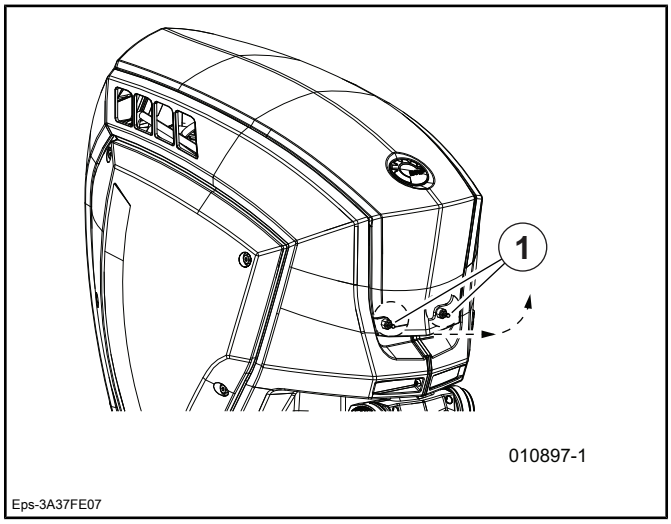
H	Outboard Lubricant
X	See Service Manual Procedure

Covers: Top, Rear and Optional Side Panels

Top Cover

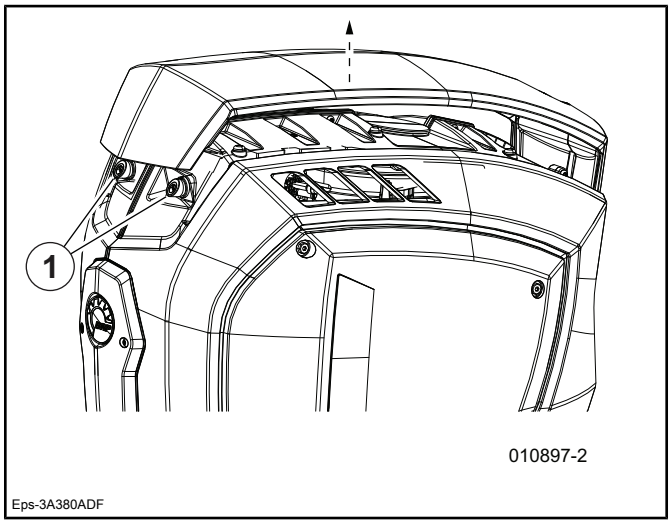
Removal

The top cover is retained by two pins on the lower front edge and two rubber bumpers at the rear air intake. Carefully pull the lower front edge to release the to cover from the pins.



1. Pins

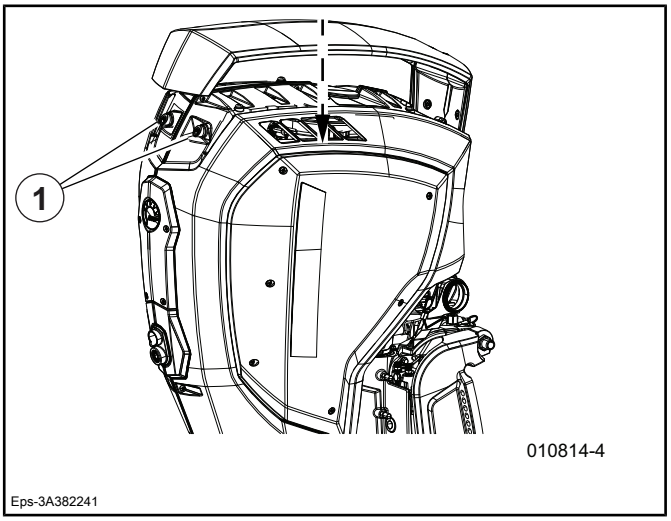
Carefully pull the lower edge of the rear air intake to release the to cover from the bumpers. Then lift the top cover from the frames.



1. Bumpers

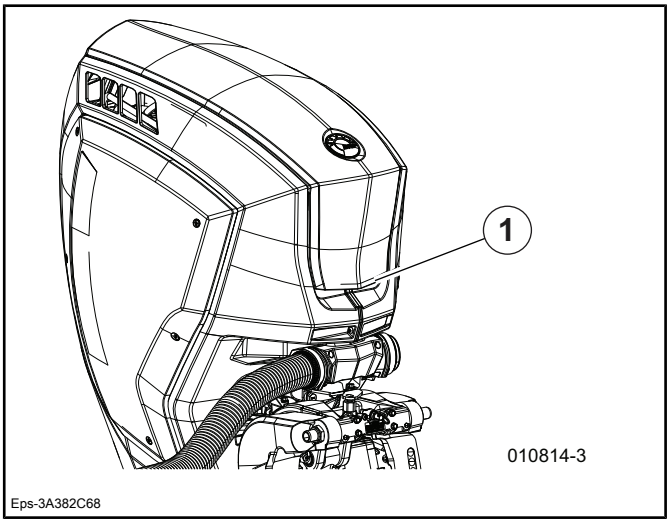
Installation

Lower the cover onto the frames. Align the rear air intake onto the bumpers.



1. Bumpers

Carefully pull the lower front edge and align the to cover with the pins. Then push on the lower front edge to lock the top cover on the pins.

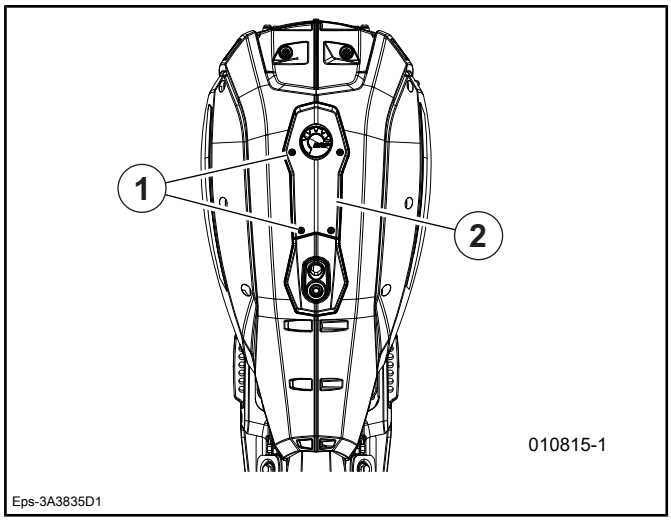


1. Push on the lower front edge

Rear Cover

Removal

Use a T-25 *Torx* driver to remove the four screws from the rear cover. Then remove the rear cover from the frames.



1. Four screws
2. Rear Cover

Installation

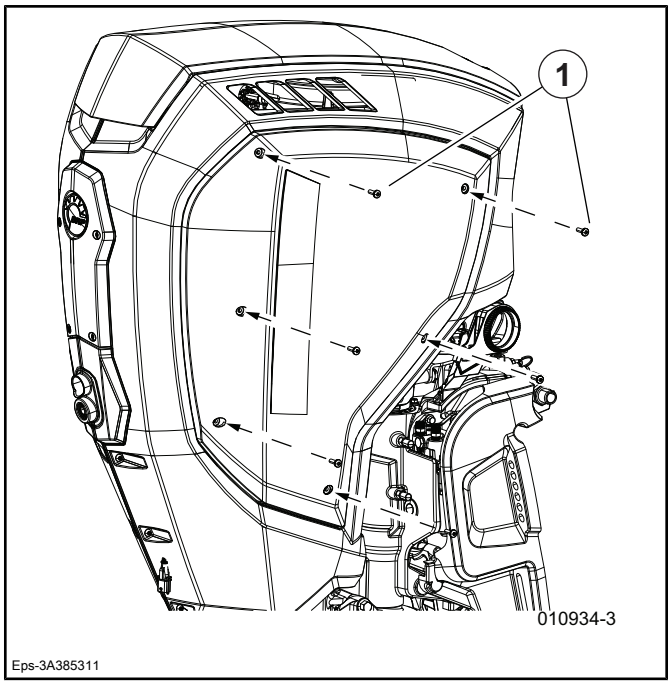
Align the rear cover on the frames. Use a T-25 *Torx* driver to install the four screws. Tighten to a torque of 15 to 22 In. lbs. (1.7 to 2.5 N·m).

Optional Accessory Side Panels

Optional accessory side panels are available in several colors and an ABS version which can be custom painted. After installing side panels there is normally no reason to remove them unless they are damaged and need to be replaced.

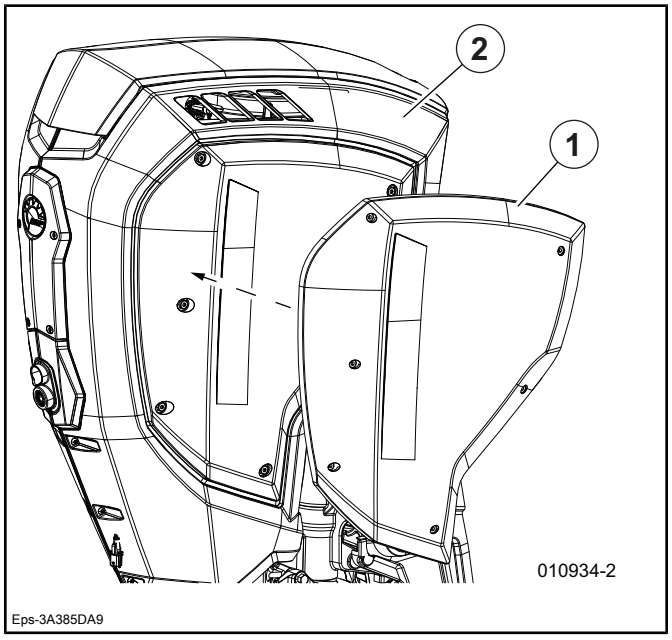
Installation

Remove six push pins from each frame.



1. Push pin

Align and place the panel on the frame.



1. Panel
2. Frame

Use an appropriate *Torx* driver to install six self-taping screws, P/N 361214, into each panel.

Tighten screws to a torque of 25 to 35 In. lbs. (2.8 to 3.9 N·m).

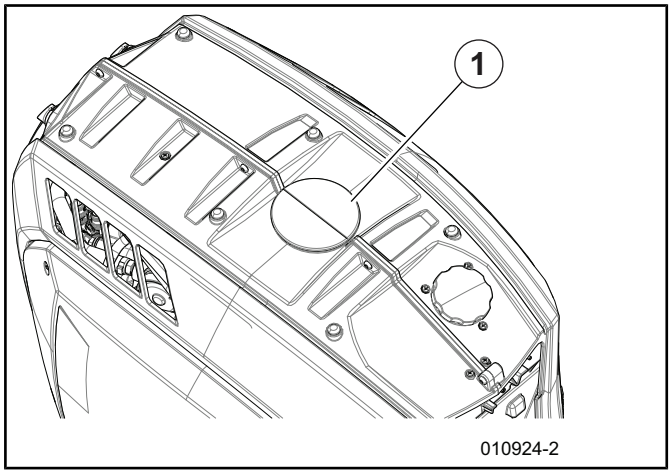
IMPORTANT: If panels are removed and reinstalled: When installing screws be sure to turn self-tapping screws counterclockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the frame.

Port and Starboard Frames

Starboard Frame

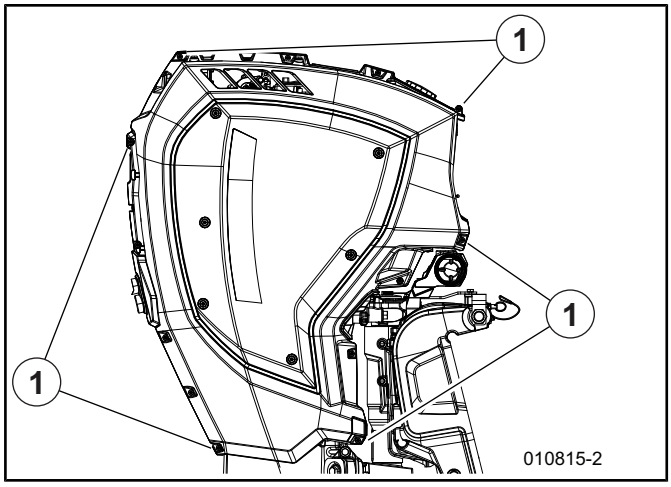
Removal

Remove the top cover and rear cover. Then remove the 4 inch frame plug.



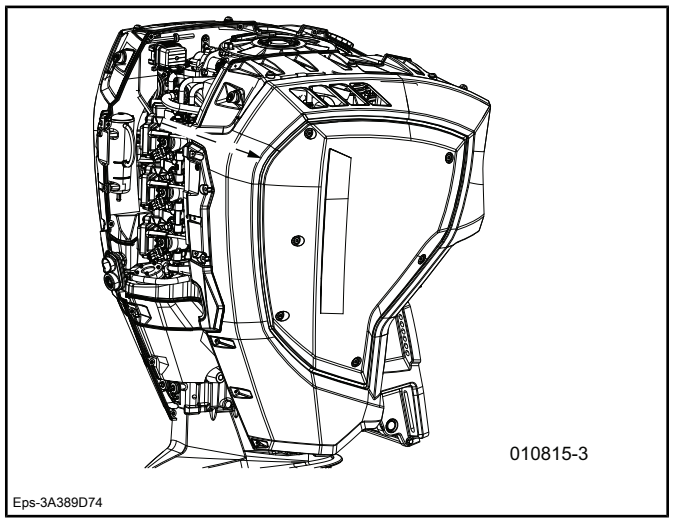
1. 4 inch frame plug

Remove the top cover, then remove the rear cover. Use a T-25 *Torx* driver to remove 13 screws retaining the starboard frame to the port frame.



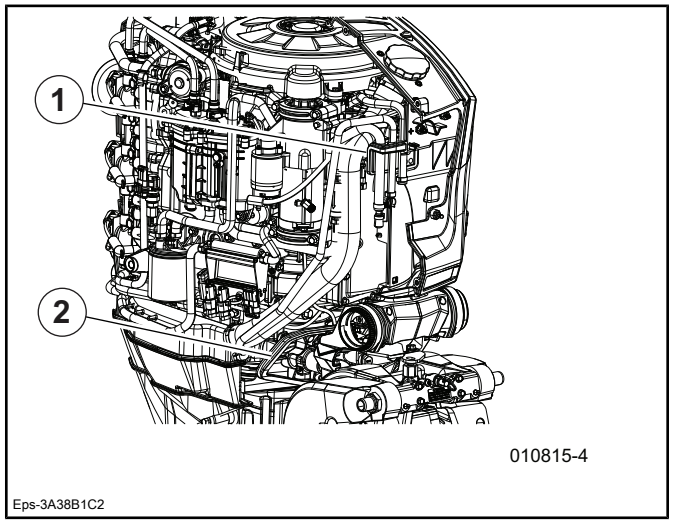
1. 13 Screws

Carefully remove the starboard frame from the outboard.



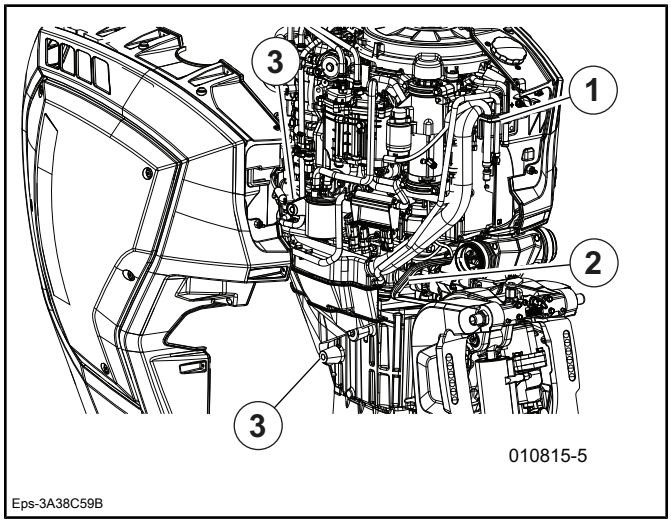
Installation

Apply soapy water to the rigging grommet and seal.



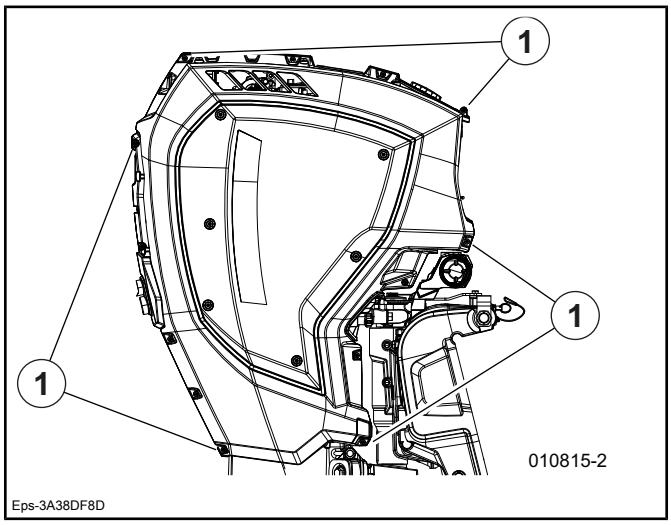
1. Rigging grommet
2. Seal

Place the starboard frame on the outboard. Be SURE to align the rigging grommet, seal and bumpers. When the frame is in place correctly, there will be minimum gap between the frames.



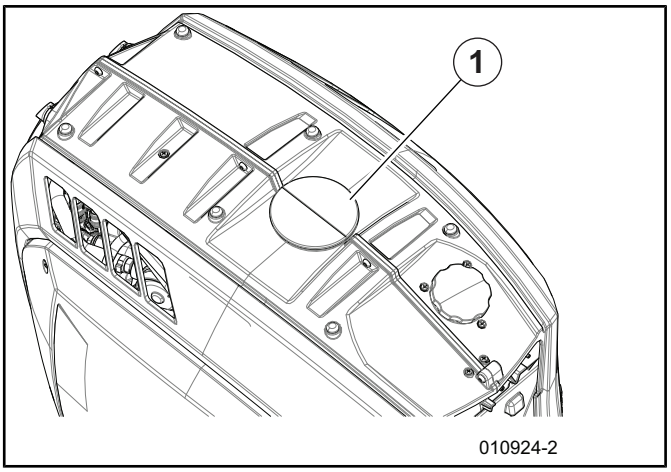
1. Rigging grommet
2. Seal
3. Bumpers

Use a T-25 *Torx* driver to install the13 screws retaining the starboard frame to the port frame. Tighten screws to a torque of 15 to 22 In. lbs. (1.7 to 2.5 N·m).



1. 13 Screws

Install the 4 inch frame plug.



1. 4 inch frame plug

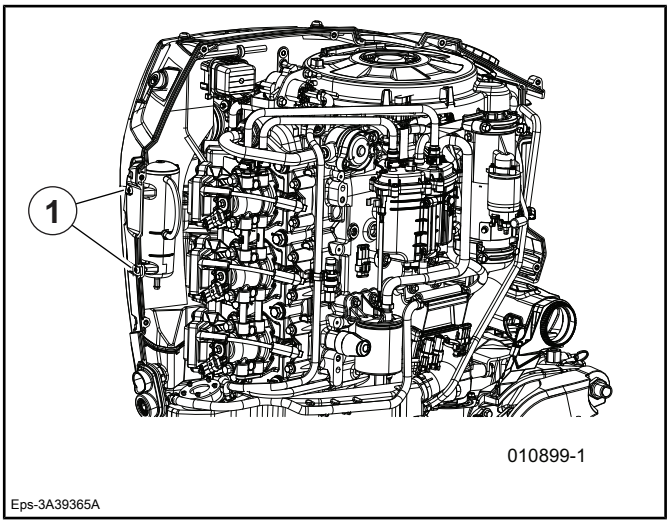
Port Frame

Removal

Disconnect the battery cables from the battery. Disconnect the negative (–) battery cable first. Then disconnect the positive (+) battery cable.

Remove the starboard frame. Refer to **Starboard Frame**.

Use a T-25 Torx driver to remove the two screws retaining the oil reservoir to the port frame.



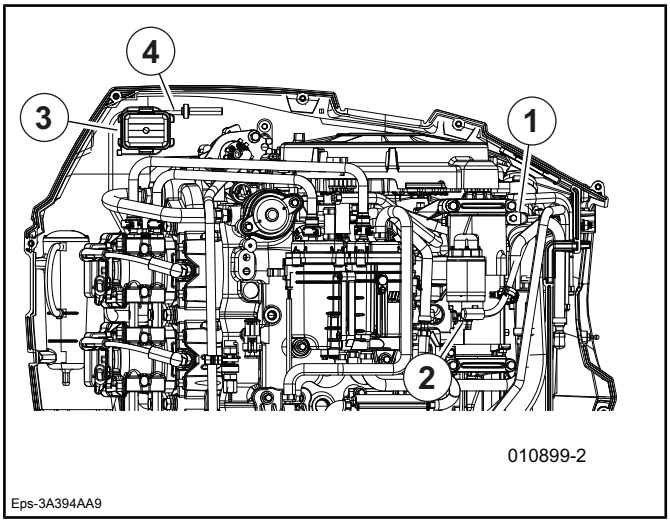
1. Screws

Disconnect the negative (–) cable from the upper starter motor mounting bracket.

Disconnect the positive (+) cable from the starter solenoid.

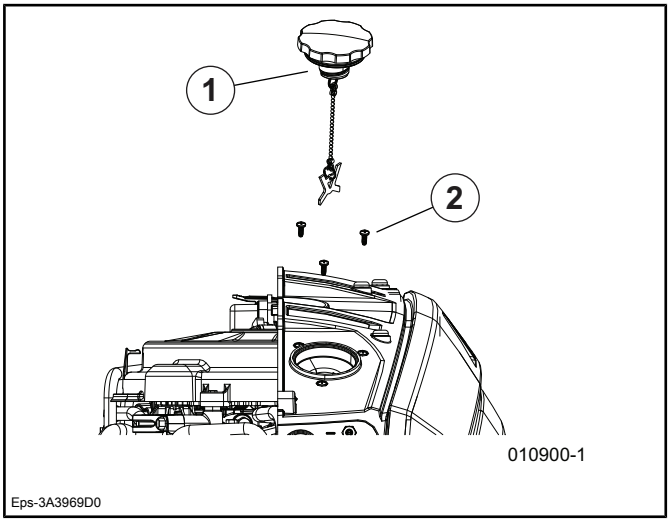
Release the fuse box from its retaining clips on the port frame.

Release the oil tank vent and vent hose from the retainers on the port frame.



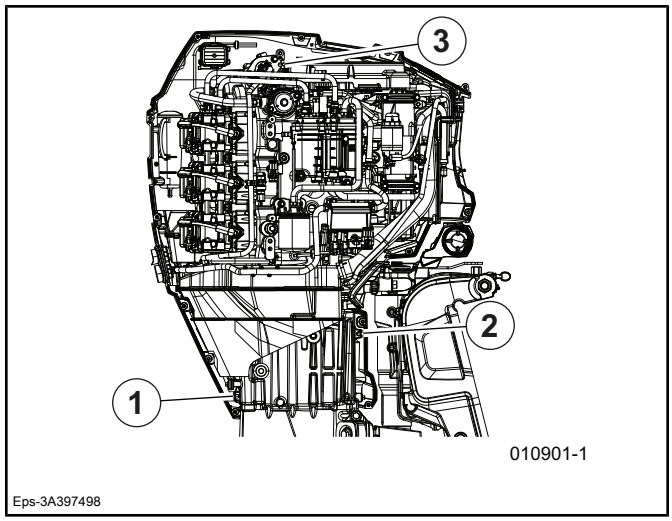
1. *Negative (–) cable*
2. *Positive (+) cable*
3. *Fuse box*
4. *Oil tank vent and hose*

Remove the oil fill cap from the oil filler neck. Then remove the three screws from the filler neck.



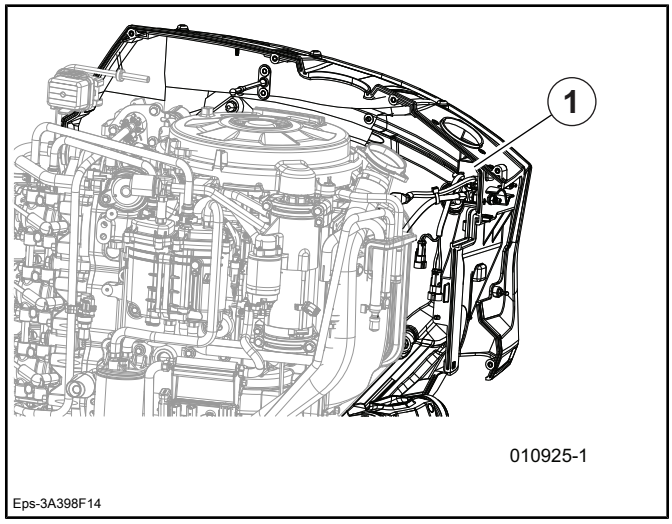
1. *Oil fill cap*
2. *Three screws*

Release the three rubber straps from the lower rear of the exhaust housing, upper front of the exhaust housing and the oil pump mounting bracket.



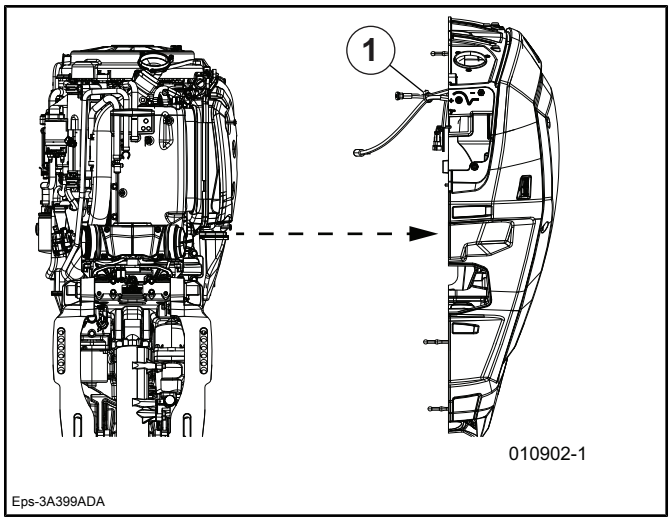
1. *Lower rear of exhaust housing*
2. *Upper front of exhaust housing*
3. *Oil pump mounting bracket*

As the port frame is removed, disconnect the trim relay from the engine harness and trim motor. The trim relay should stay with the frame as the power and ground cables are attached to the battery cable studs.



1. *Trim relay*

Make note of the routing of the starter solenoid and ground cables. Guide the cables as the port frame is removed from the outboard

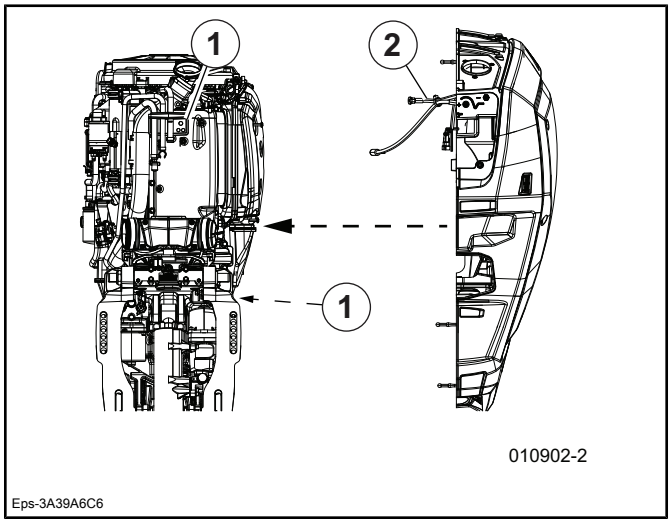


1. Starter solenoid and ground cables

Installation

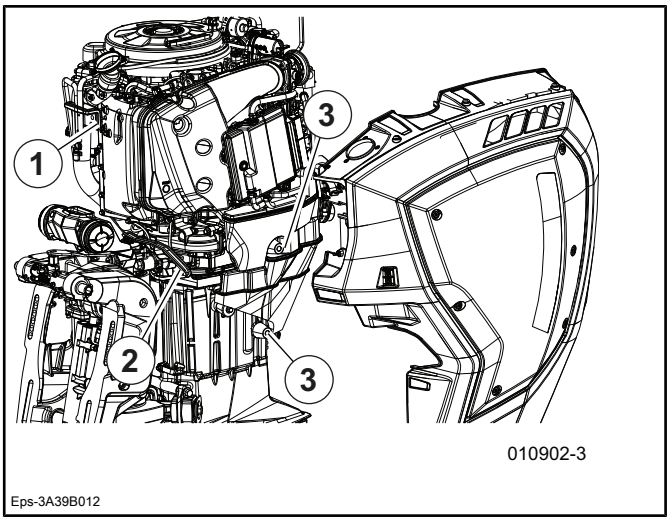
Apply soapy water to the rigging grommet and seal.

Refer to starter solenoid and ground cables routing notes. Guide the cables as the port frame is installed on the outboard.



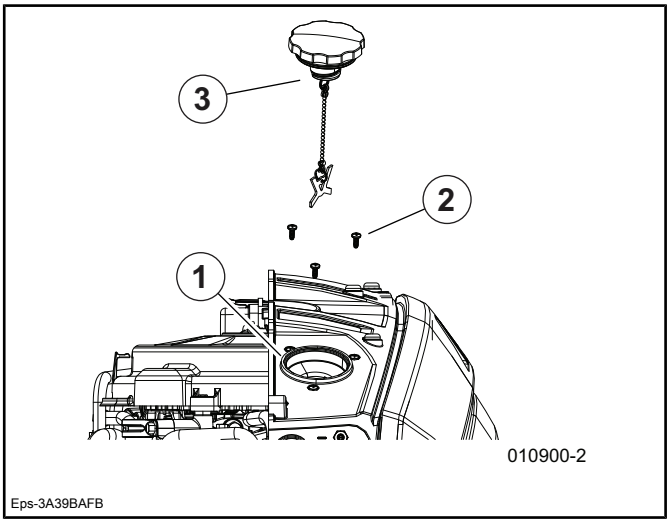
1. Rigging grommet and seal
2. Cables

As the port frame is placed, connect the trim relay from the engine harness and trim motor. Continue placing the frame. Be SURE to align the rigging grommet, seal and bumpers.



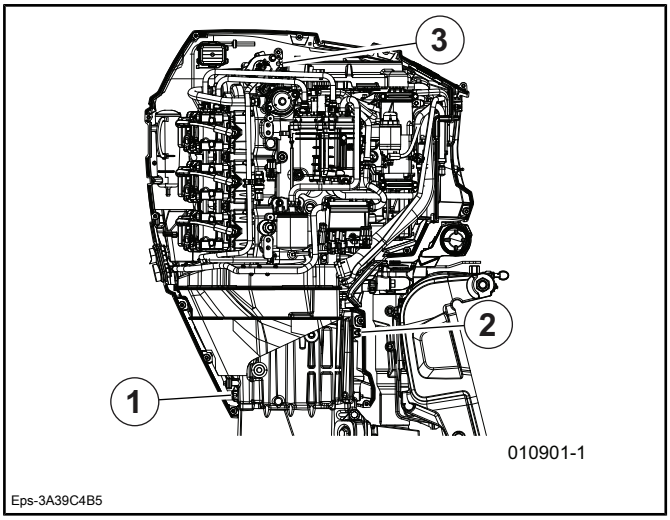
1. Rigging grommet
2. Seal
3. Bumpers

Align the oil filler neck with the frame and secure with three screws. Tighten the screws to a torque of 25 to 35 In. lbs. (2.8 to 3.9 N·m). Then install the oil fill cap.



1. Oil fill neck
2. Three screws
3. Oil fill cap

Connect the three rubber straps to the lower rear of the exhaust housing, upper front of the exhaust housing and the oil pump mounting bracket.



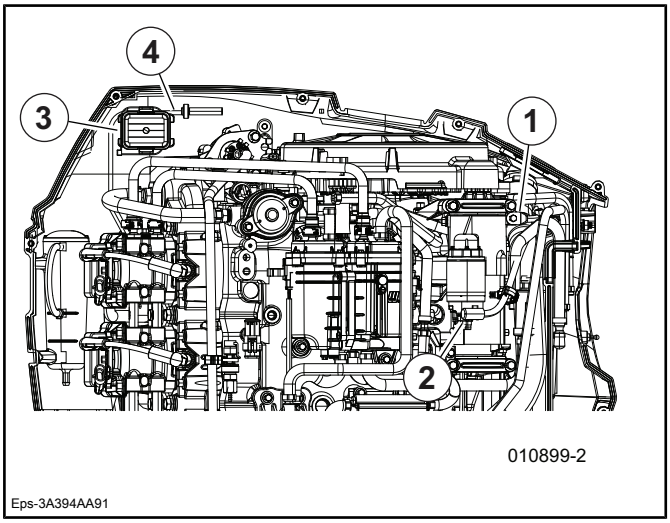
1. Lower rear of exhaust housing
2. Upper front of exhaust housing
3. Oil pump mounting bracket

Connect the negative (–) cable from the upper starter motor mounting bracket.

Connect the positive (+) cable from the starter solenoid.

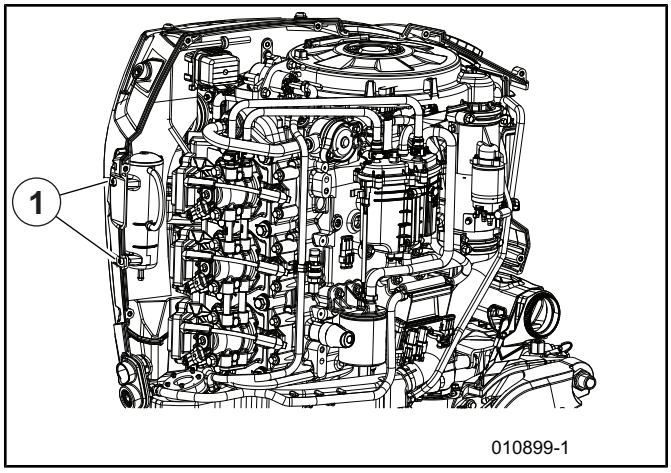
Place the fuse box in its retaining clips on the port frame.

Place the oil tank vent and vent hose in the retainers on the port frame.



1. Negative (–) cable
2. Positive (+) cable
3. Fuse box
4. Oil tank vent and hose

Place the gearcase oil reservoir into the port frame. Use a T-25 *Torx* driver to install the two screws and tighten to a torque of 25 to 35 In. lbs. (2.8 to 3.9 N·m).



1. Screws

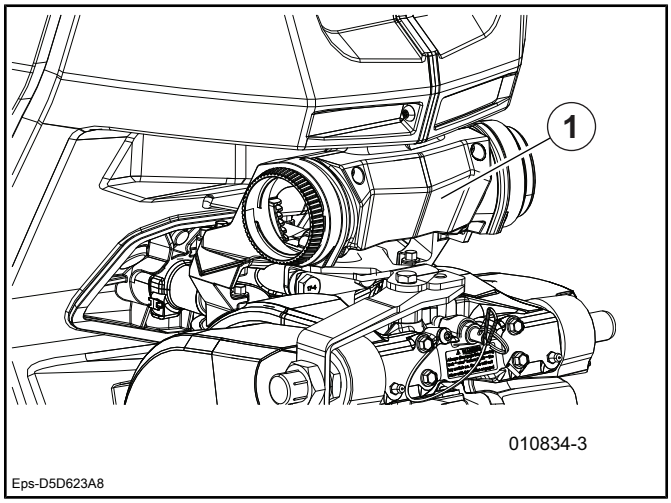
Install the starboard frame. Refer to **Starboard Frame**.

Connect the battery cables at the battery. Connect the positive (+) battery cable first. Then connect the negative (–) battery cable.

Rigging Housing

Rigging Housing Access

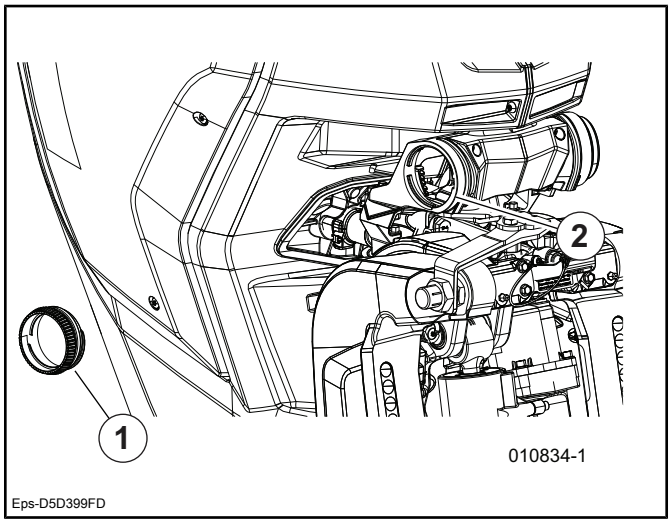
Evinrude E-TEC G2 models utilize a central rigging center. All buss cables, hydraulic steering, fuel and oil hoses and other rigging enter the rigging center through a cable entryway in the rigging housing.



1. Rigging housing

The cable entryway uses a rigging collar which provides the option to use standard or large diameter rigging hose.

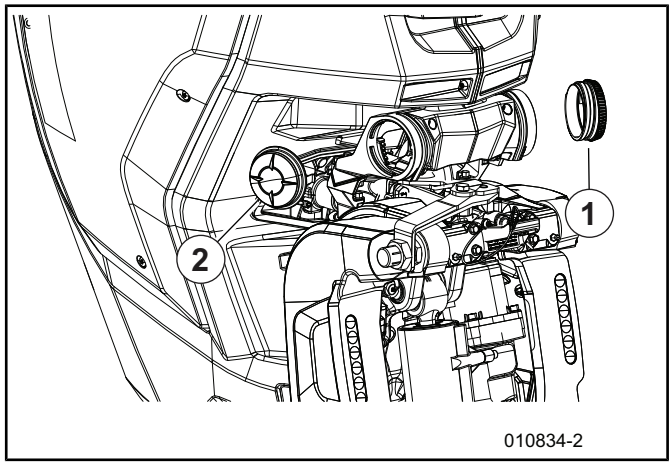
Leave the rigging collar installed to rig using 2.0 inch (51 mm) diameter rigging hose, such as P/N 770392, or P/N 770393. Turn the rigging collar clockwise to remove from the bracket to rig using 2.4 inch(61 mm) diameter rigging hose, such as P/N 362031.



1. Rigging collar
2. Bracket

Cable Entryway

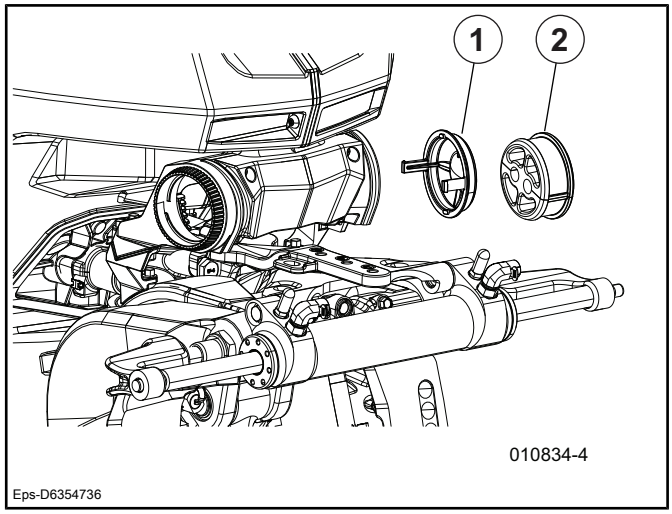
The cable entryway leaves the factory set up for starboard cable entry but can be adapted for port cable entry. Remove the rigging collar and cap from their brackets. Swap sides to adapt for port cable entry.



1. Rigging collar
2. Cap

Non-Power Steering Models

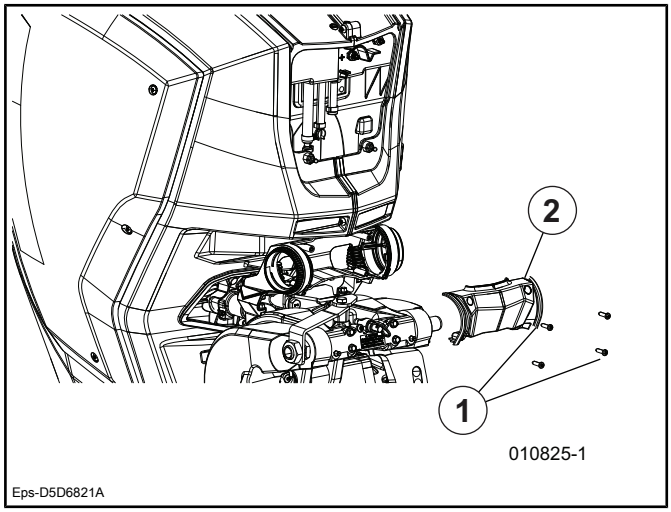
An hydraulic steering hose grommet is provided with non-power steering models that use an external hydraulic steering cylinder. Remove the cap from the rigging center. After the hydraulic steering hoses are routed thru the rigging center install the grommet over the hoses and insert the grommet in place of the cap. Refer to the current ***Evinrude E-TEC G2* I3 Installation and Predelivery Guide**.



1. Cap
2. Hydraulic steering hose grommet

Front Cover

Remove the four screws retaining the front cover. Remove the cover.



1. *Four screws*
2. *Cable entry cover*

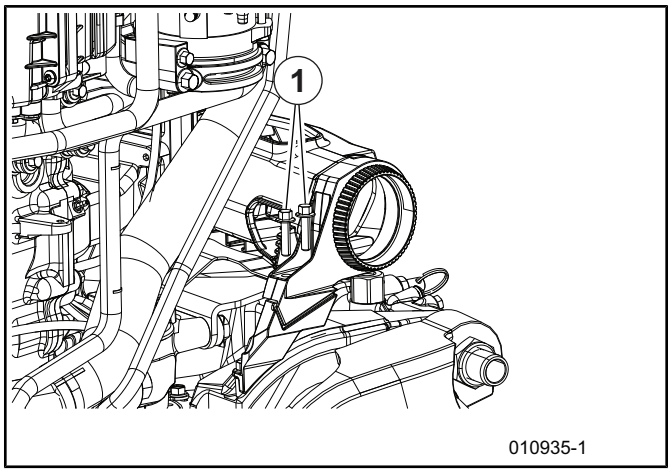
Align the cover on the rigging housing and push to snap it into place. Secure the cover with four screws. Tighten the screws to a torque of 18 to 30 In. lbs. (2 to 3.4 N·m).

IMPORTANT: When installing screws be sure to turn self-tapping screws counterclockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the rigging housing.

Rigging Center Removal

To remove the rigging center in one piece, the front cover must be installed.

Remove four screws, two on each rigging center bracket. Then remove the rigging center from the brackets.



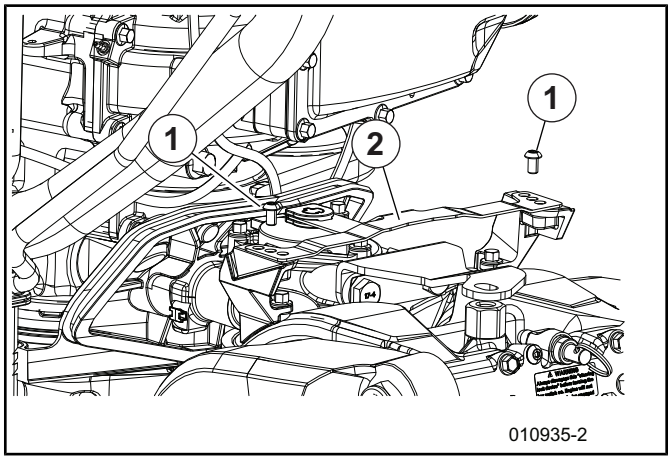
1. *Screws (starboard side shown)*

Rigging Center Installation

Position the rigging center brackets on the mounting brackets and install two screws per bracket. Tighten the screws to a torque of 50 to 70 In. lbs. (5.6 to 7.9 N·m).

Steering Position Sensor Bracket Removal (Power Steering Models Only)

Remove the two screws retaining the steering position sensor bracket. Then remove the bracket.



1. *Two screws*
2. *Steering position sensor bracket*

Steering Position Sensor Bracket Installation

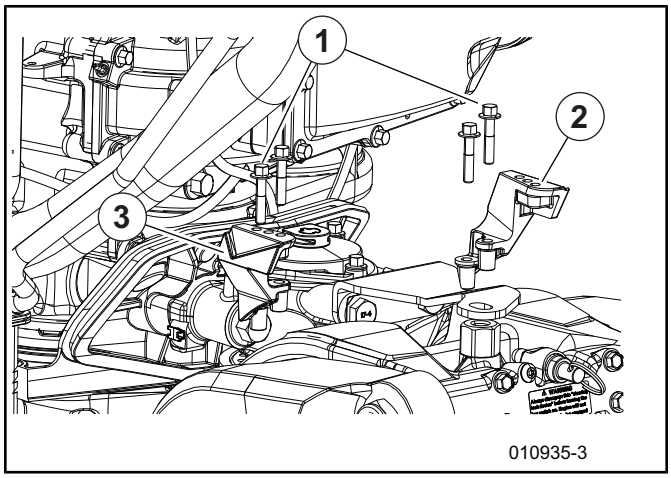
Install the steering position sensor bracket into the sensor grommet. Secure the bracket with two

screws. Tighten the screws to a torque of 60 to 84 In. lbs. (6.7 to 9.5 N·m).

IMPORTANT: The steering position sensor MUST be calibrated BEFORE retuning the outboard to service..

Mounting Bracket Removal

Remove four screws, two on each rigging center mounting bracket. Then remove the port and starboard mounting brackets.



1. *Four screws*
2. *Port mounting bracket*
3. *Starboard mounting bracket*

Mounting Bracket Installation

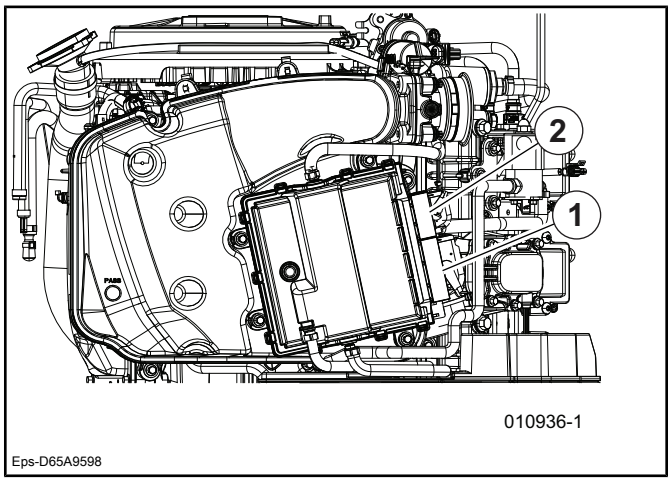
Mounting brackets are specific to the port and starboard stern brackets and are NOT interchangeable. Install the mounting brackets in their original locations with two screws per bracket. Tighten screws to a torque of 60 to 84 In. lbs. (6.7 to 9.5 N·m).

Engine and Control Systems

Engine Management Module (*EMM*)

The Engine Management Module (*EMM*) is a water-cooled controller. It controls engine management and engine related remote control functions.

This section discusses the functions of the *EMM* and its various internal and external sensors. It also describes using *Evinrude Diagnostics* software to retrieve and adjust service information saved in the *EMM*.



1. EMM J1 connector
2. EMM J2 Connector

EMM Functions

The *EMM* controls the following processes and functions:

- Alternator output; 55 V and 12 V
- Start Assist Circuit (SAC) voltage boost
- Fuel and ignition timing and duration
- Fuel injector activation
- Oil pump activation
- Electric fuel lift pump
- Electric high pressure fuel pump control
- Idle speed control
- RPM limiter
- Electrical circuit monitoring
- Fault code creation and storage
- Warning system activation
- ROM verification, self test
- Cold starting
- Output of diagnostic data
- Tachometer signal
- RPM profile and engine hours
- Oil pump activation
- Anti-knock compensation
- Electronic throttle control
- Electronic shift control
- Dynamic Power Steering

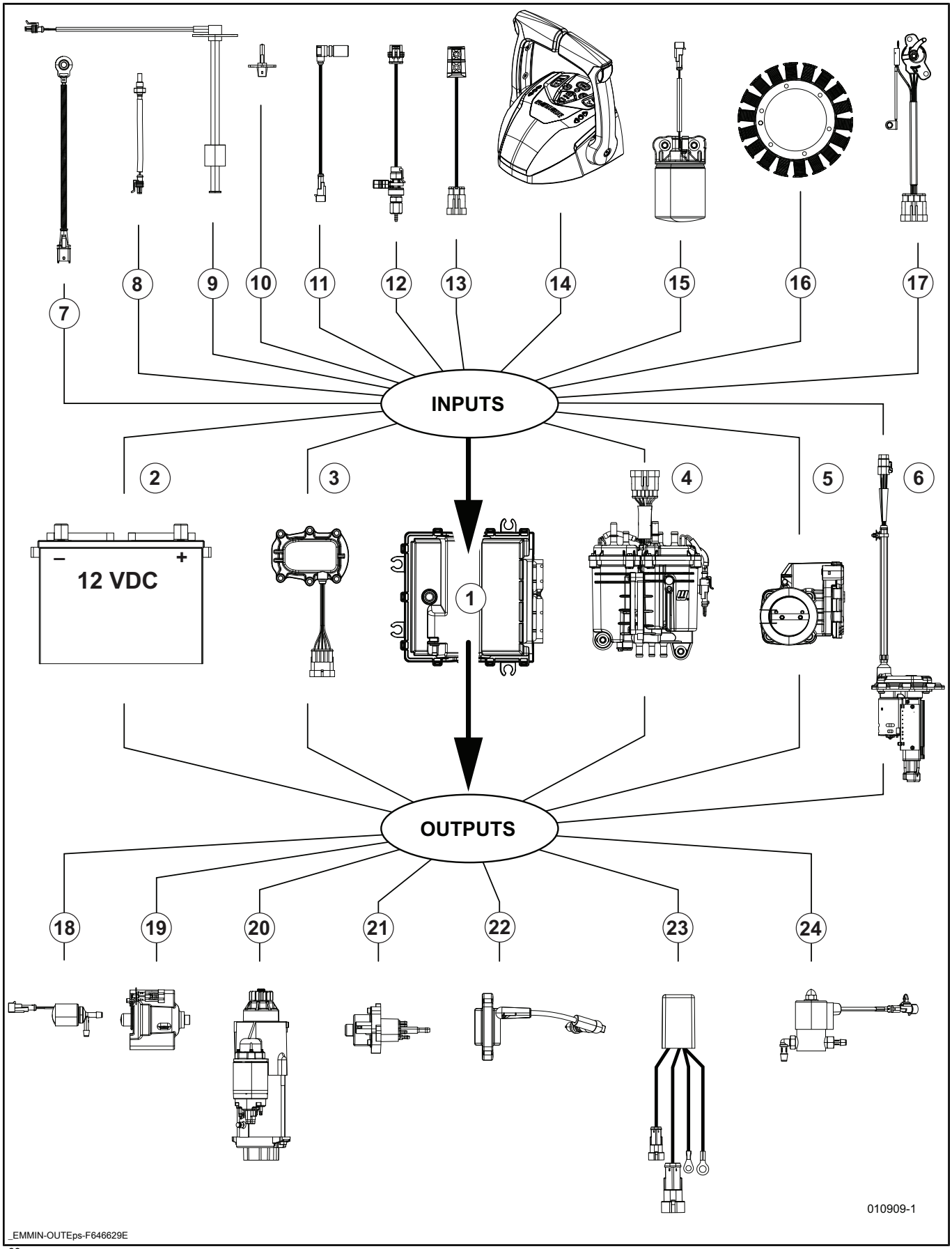
EMM Connections

IMPORTANT: *EMM* connections and wiring must be clean and tight. Improper electrical connections can damage the *EMM*. DO NOT run the outboard with loose or disconnected wiring.

Make sure *EMM* connections are clean and tight.

- Engine wire harness to *EMM* connectors; J1, J2.
- Stator to *EMM* connections; one 6-pin AMP and J2 connector.

EMM Inputs and Outputs Diagram



_EMMIN-OUTEps-F646629E

1. *EMM*
2. 12 VDC Battery
3. RAVE Actuator
4. Fuel Vapor Separator
5. Electronic Throttle Body
6. Shift Actuator
7. Knock Sensor
8. Engine Temperature Sensor
9. Engine Oil Level Sender
10. Crankshaft Position Sensor
11. Intake Air Temperature Sensor
12. Water Pressure Sensor (optional accessory)
13. Trim Switch
14. Digital Remote Control
15. Water in Fuel Sensor
16. Stator
17. Trim Sender
18. Vapor Vent Solenoid
19. Fuel Injector (3)
20. Starter Solenoid and Motor
21. Oil Pump
22. Ignition Coil (3)
23. Trim and Tilt Relay
24. Water Valve
25. Digital Displays and Gauges
26. (reserved for future use)

Engine Control Systems

Sensor inputs and internal *EMM* controllers are used to control the outboard's engine operation.

Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** for a complete list of all engine fault codes.

Internal Sensors

Internal sensors are NOT serviceable. Reprogramming or replacement may be required to resolve *EMM* related issues.

EMM Temperature Sensor

Monitors the temperature of the fuel injector driver circuits.

If the EMM temperature exceeds 176ºF (80ºC) or the circuit fails, the *EMM*:

– Activates *S.A.F.E*
– Stores fault code 25
– Engine Monitor: TEMP display ON

If *EMM* temperature exceeds 212ºF (100ºC) or the circuit fails, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 29
– Engine Monitor: TEMP display ON

IMPORTANT: The outboard will not restart until the engine cools below 212ºF (100ºC) and the EMM temperature returns to normal. Refer to **Shutdown Mde**.

If *EMM* temperature is less than -22ºF (-30ºC) or the circuit fails, the *EMM*:

– Stores fault code 24

If sensor reads less than -67ºF (-55ºC) or greater than 311ºF (155ºC) a sensor circuit fault is detected and the *EMM*:

– Stores fault code 23

55 V Circuit Sensor

Monitors the *EMM*'s 55 V alternator circuit.

If system voltage exceeds 57 volts, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 18
– Engine Monitor: CHECK ENGINE display ON

If system voltage is less than 45 V between 500 and 1000 RPM, or is less than 52 V above 1000 RPM, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 17
– Engine Monitor: CHECK ENGINE display ON

12 V Circuit Sensor

Monitors the *EMM*'s 12 V alternator circuit.

If battery voltage exceeds 15.5 volts, the *EMM*:

– Stores fault code 27
– Engine Monitor: BATTERY display ON

If battery voltage is less than 12 V below 2000 RPM, or is less than 12.5 V above 2000 RPM, the *EMM*:

– Stores fault code 26
– Engine Monitor: BATTERY display ON

5 V Circuit Sensor

Monitors the *EMM*'s 5 V sensor circuit.

If sensor voltage is less than 4.75 volts, the *EMM*:

– Stores fault code 78

Barometric Pressure Sensor

Supplies the *EMM* with barometric pressure reading to compensate for changes in altitude and air density.

If the BP sensor reads less than 13 KPa or greater than 119.0 KPa, or the sensor or circuit fails, the *EMM*:

– Stores fault code 44

If the BP sensor reads less than 70 KPa, the *EMM*:

– Stores fault code 45

If the BP sensor reads greater than 105 KPa, the *EMM*:

– Stores fault code 46

Exhaust Pressure Sensor

The exhaust pressure sensor monitors exhaust pressure during all running conditions to compensate for engine loads.

If the sensor reads less than -85 in. water, or greater than 85 in. water, or the sensor or circuit fails, the *EMM*:

– Stores fault code 87

If exhaust pressure is less than –40 in. water, the *EMM*:

– Stores fault code 88

If exhaust pressure is greater than 80 in. water, the *EMM*:

– Stores fault code 89

External Sensors

Sensor inputs and internal *EMM* controllers are used to control outboard operation. Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** at the back of this manual for a complete list of all engine fault codes.

The *EMM* provides a 5 V DC signal for sensor circuits. It monitors all sensor voltage inputs and compares them to predetermined acceptable ranges. Inputs that fall outside of the acceptable range create fault codes.

Air Temperature Sensor

The air temperature sensor monitors the air temperature at the plenum.

If the AT sensor temperature value is below –22ºF (-30ºC), the *EMM*:

– Stores fault code 48
– Engine Monitor: TEMP display ON

If the AT sensor temperature value exceeds 158ºF (70ºC), the *EMM*:

– Stores fault code 49
– Engine Monitor: TEMP display ON

If the AT sensor circuit fails, the *EMM*:

– Stores fault code 47
– Engine Monitor: TEMP display ON

Engine Temperature Sensor

Monitors cylinder head temperature.

If cylinder head temperature exceeds 194ºF ±3ºF (90ºC ±1.6ºC) above 3500 RPM for 3 seconds, the *EMM*:

– Stores fault code 43 (port sensor)
– Stores fault code 69 (starboard sensor)
– Engine Monitor: TEMP display ON

If the cylinder head temperature exceeds 212ºF (100ºC) below 3500 RPM, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 40 (port sensor)
– Stores fault code 70 (starboard sensor)
– Engine Monitor: TEMP display ON

If cylinder head temperature exceeds 239ºF (115ºC) for 3 seconds, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 31
– Engine Monitor: TEMP display ON

The outboard will not restart until the engine temperature returns to normal. Refer to **Shutdown Mode**.

If sensor values are less than -13ºF (-25ºC), or greater than 329ºF (165ºC), the *EMM*:

– Stores fault code 41 (port sensor)
– Stores fault code 67 (starboard sensor)

If sensor values are below -4ºF (-20ºC), the *EMM*:

– Stores fault code 42 (port sensor)
– Stores fault code 68 (starboard sensor)

If cylinder head does not reach operating temperature (122ºF / 50ºC below 1000 RPM) in 10 minutes, the *EMM*:

– Stores fault code 58 (port sensor)
– Stores fault code 59 (starboard sensor)

Internal *EMM* Functions

ROM Verification

The *EMM* performs a self-test of programming every time it is turned ON. Fault code 15 indicates a programming (software) issue. Reprogram the *EMM* with the correct software program to correct the problem.

Start Assist Circuit

When the ignition key is ON, the *EMM* Start Assist Circuit (SAC) boosts battery voltage (12 V) to 30 V on the system (55 V) circuit.

If the SAC circuit current exceeds 2 Amps, or if the SAC voltage is less than 20 V, the *EMM*:

– Stores fault code 77

Idle Controller

The idle controller reacts to engine operating conditions. Fuel and ignition timings are altered to maintain a specific RPM when engine is cold or warm. The controller is inactive when the TPS is advanced from idle position.

Electronic Throttle Controller

Refer to **Electronic Throttle Controller**.

Electronic Shift Controller

Refer to **Electronic Shift Controller**.

Dynamic Power Steering

Refer to **Dynamic Power Steering (DPS)**.

RPM Limiter

This feature of the EMM programming prevents engine damage due to excessive RPM.

At 6250 RPM, fuel and ignition to the cylinders is shut off. Normal operation resumes when engine RPM returns to the specified range.

Neutral RPM Limiter

This feature prevents engine damage due to excessive RPM if accelerated in NEUTRAL. Neutral engine speed is limited to 1100 RPM.

Engine Monitor and Warning Systems

Refer to **Engine Monitor System**.

Refer to **S.A.F.E.**

Refer to **Shutdown Mode**.

Fault Code Creation and Storage

Refer to the **Fault Code Chart** at the back of this manual for a complete list of all engine fault codes.

Throttle, Shift and Steering Control Systems

Shift and throttle information is transmitted and received between the *EMM* and *ICON II* remote control system via a dedicated Controller Area Network (CAN), known as the remote control network, or private network. For safety, information is also shared on a *NMEA 2000* network as backup.

Sensor inputs and internal *EMM* controllers are used to control the operation of the outboard's shift and throttle functions.

Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** for a complete list of all control system fault codes.

Reprogramming or replacement may be required to resolve *EMM* related issues.

Electronic Throttle Controller

The *EMM* receives inputs from the remote control via the remote control network. The *EMM* transmits the input signals to the Electronic Throttle Controller (ETC). The ETC processes the inputs and sends signals to the Electronic Throttle Body (ETB). The ETB converts the signals to movement of the throttle plate. The ETB consists of a motor assembly, throttle plate and two Throttle Position Sensors (TPS), "TPS A" and "TPS B".

Each TPS receives a voltage signal from the *EMM*. As the throttle lever is rotated, the *EMM* receives a return voltage signal through a second wire. A third wire provides a ground circuit back to the *EMM*.

TPS A and TPS B voltages are correlated. As the throttle plate opens, TPS A voltage increases and TPS B voltage decreases. As the throttle plate closes, TPS A voltage decreases and TPS B voltage increases.

The EMM monitors the TPS connections and voltages on the remote control network.

If communication from co-processor to processor is lost for more than 250 milliseconds, the EMM:

– Activates *S.A.F.E.*
– Stores fault code 162
– Engine Monitor: CHECK ENGINE display ON

If co-processor safety messages are not being received, or if co-processor cannot disable driver, the EMM:

– Activates *S.A.F.E.*
– Stores fault code 183
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the TPS voltage. If TPS A voltage is less than 0.17 V, the *EMM*:

– Stores fault code 163

If TPS A voltage is greater than 4.92 V, the *EMM*:

– Stores fault code 164

If TPS B voltage is less than 0.07 V, the *EMM*:

– Stores fault code 165

If TPS B voltage is greater than 4.82 V, the *EMM*:

– Stores fault code 166

If TPS correlated voltages are out of range, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 167
– Engine Monitor: CHECK ENGINE display ON

If TPS A voltage is outside of 0.25 V to 1.47 V or TPS B voltage is outside 3.53 V to 4.75 V at key on, the TPS is out of idle range. The *EMM*:

– Stores fault code 168

If signal from TPS A and TPS B are lost, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 175
– Engine Monitor: CHECK ENGINE display ON

If sensor reference voltage is fluctuating, but a sensor fault is NOT detected, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 182
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors remote control lever position for out of range values. If the communication message values are greater than 1000 or less than 65535, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 172
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ETC motor circuit. If the *EMM* detects the ETC circuit is OPEN, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 173
– Engine Monitor: CHECK ENGINE display ON

If the *EMM* detects excessive current draw, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 174
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the throttle plate position. The throttle plate position is compared to the commanded position. If the difference is greater than 7% while the commanded position is not changing, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 179
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors how much effort is required to move the throttle plate. When the 20ms duty cycle sum is greater than 5500, the throttle plate requires too much effort to move. The *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 180
– Engine Monitor: CHECK ENGINE display ON

If the key is turned on but the engine is not immediately started, the *EMM* checks throttle plate movement. If the throttle plate cannot close less than or equal to 10%, or if it cannot open greater than or equal to 80%, the throttle plate is not functioning correctly. The *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 191
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ETC driver voltage, temperature and current. If any of these values are out of range, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 181
– Engine Monitor: CHECK ENGINE display ON

Electronic Shift Controller

The *EMM* receives inputs from the remote control via the remote control network. The *EMM* transmits the input signals to the Electronic Shift Controller (ESC). The ESC processes the inputs and transmits signals to the shift actuator. The shift actuator consists of a motor assembly, a Shift Position Sensor (SPS), and a NEUTRAL switch. The motor assembly drives the mechanical shift mechanism, while the SPS and NEUTRAL switch send actual gear position back to the *EMM*.

The *EMM* monitors the Shift Position Sensor (SPS).

If the SPS voltage is less than 0.25 V, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 195
– Engine Monitor: CHECK ENGINE display ON

If the SPS voltage is greater than 4.75 V, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 196

– Engine Monitor: CHECK ENGINE display ON

If the shift actuator cannot achieve the commanded gear, the *EMM*:

– Activates *S.A.F.E.*
– Activates SHUTDOWN (if NEUTRAL cannot be achieved)
– Stores fault code 204
– Engine Monitor: CHECK ENGINE display ON

If the SPS position differs from the NEUTRAL switch position, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 201
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors for undesired actuator movement when the actuator is in FORWARD, NEUTRAL, or REVERSE. If movement is detected, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 205
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the shift actuator NEUTRAL switch.

If the NEUTRAL switch voltage is less than 0.5 V, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 197
– Engine Monitor: CHECK ENGINE display ON

If the NEUTRAL switch voltage is greater than 4.5 V, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 198
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors shift calibration. If the FORWARD or REVERSE calibration exceeds the limits saved in the *EMM*, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 199
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ESC driver current. If the current exceeds 50 A, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 200
– Engine Monitor: CHECK ENGINE display ON

The *EMM* monitors the ESC motor circuit.

If the *EMM* detects the ESC motor circuit is OPEN, the *EMM*:

– Activates SHUTDOWN
– Stores fault code 207
– Engine Monitor: CHECK ENGINE display ON

Engine Monitor System

System Self-Test

During engine start-up, pause with the key switch in the ON position. Digital displays and gauges will self test as follows:

Engine Running

All warning circuits are active when the engine is running. The horn circuit is active when engine speed exceeds 500 RPM.

Engine monitor warnings activate the horn (if equipped) for 10 seconds and the appropriate gauge light for a minimum of 30 seconds. If the failure is momentary (for example, oil moving in the tank), the light will remain ON for the full 30 seconds before going out. If the fault continues, the light remains ON until the key is turned OFF or the failure is corrected. The warning will reoccur at the next start-up if the problem is not corrected.

S.A.F.E.

The *S. A. F. E.* (Speed Adjusting Failsafe Electronics) warning system alerts the operator and protects against engine damage from the following abnormal conditions:

Code	Description
1–6	Excessive knock detected
17	Alternator 55 V below expected range
18	Alternator 55 V above expected range
25	*EMM* temperature above expected range
34	Crankcase oil pump OPEN circuit
36	Cylinder oil pump OPEN circuit
40	Cylinder head temperature above expected range–low speed
43	PORT Cylinder head temperature above expected range
69	STARBOARD cylinder head temperature above expected range
70	Cylinder head temperature above expected range–low speed
117	Critical LOW OIL detected
132	Vapor separator upper level switch OPEN circuit
133	Vapor separator lower level switch OPEN circuit
136	Exhaust Temperature above limit
137	Vapor separator low fuel level detected
162	ETC shutdown
167	ETC TPS Signal OOC
172	ETC lever Position out of range
173	ETC motor OPEN circuit
174	ETC motor excessive current
175	ETC TPS stability performance
179	ETC running error fault
180	ETC running effort fault
181	ETC drive status fault
182	ETC system critical fault
183	Controller level monitoring error
191	ETC step response failure
204	ESC Cannot achieve desired gear

Activation

When one of these conditions occurs, the *EMM* interrupts fuel injector and ignition operation, reducing engine speed to 1200 RPM. The warning horn sounds (if equipped) and an Engine Monitor message displays. When *S.A.F.E.* is active, the engine will run normally below 1200 RPM. Above 1200 RPM, the engine will shake excessively.

Recovery

The engine will operate in *S.A.F.E.* as long as the fault condition exists. To recover normal operation, two conditions must be met:

– Sensor or switch readings must be back within normal limits
– The *EMM* must be reset—stop the engine (key switch OFF) and restart

Shutdown Mode

Outboard "shutdown" will occur if specific faults are detected by the *EMM*.

Conditions that initiate shutdown

Code	Description
15	ROM checksum error
29	Excessive *EMM* temperature
31	Excessive engine temperature
33	Excessive NO OIL condition
57	High RPM with low TPS setting
199	SHIFT calibration invalid
200	ESC driver status flag
201	ESC Position Sensors OOC
203	ESC Motor OPEN circuit
204	ESC Cannot achieve desired gear
205	ESC System Critical Fault
207	ESC Motor excessive current

Code 57 occurs when the *EMM* detects abnormally high RPM relative to the TPS position. This condition could be caused by uncontrolled fuel entering the combustion cycle. Before removing the code and STARTING the outboard, find and repair the cause.

– Check for internal fuel leakage from a leaking injector or vapor separator vent hose.

⚠ WARNING

If the engine shuts OFF and the "CHECK ENGINE" light is flashing, the engine cannot be restarted. A hazardous fuel condition may exist which could result in a fire or explosion.

Recovery

To recover from shutdown mode, the *EMM* must NOT detect the related fault at start-up.

Shutdown related to code 29 and 31:

– Engine will NOT restart until the *EMM* and/or engine temperature to return to normal.
– Correct the cooling problem.
– Use *Evinrude Diagnostics* software to clear fault code 29 or 31.

Shutdown related to code 33:

– Engine will restart and run for 1 minute before it shuts down again.
– To correct the problem, fill the tank and prime the oil system. Refer to **Oil Supply Priming**.
– Use *Evinrude Diagnostics* software to clear fault code 33.

Shutdown related to code 57:

– Engine will NOT restart until problem is corrected.
– Find and correct the problem that caused the fault BEFORE clearing the Occurred fault code.
– Requires the removal of the Occurred fault code. Use *Evinrude Diagnostics* software to clear fault code 57.

Shutdown related to codes 199, 200, 201, 203, 204, 205, or 207:

– Engine will NOT restart until problem is corrected.
– Find and correct the problem that caused the fault BEFORE clearing the *Occurred fault* code.

NOTE: Engine will re-start after key switch is cycled, as long as the fault is not active.

Diagnostic Software Functions

The *EMM* saves valuable information about the outboard and its running history. This information can be used for troubleshooting, for checking parts information, and for making service adjustments to the engine.

Use *Evinrude Diagnostics* software, version 6.4 or higher, and a laptop computer to access program information.

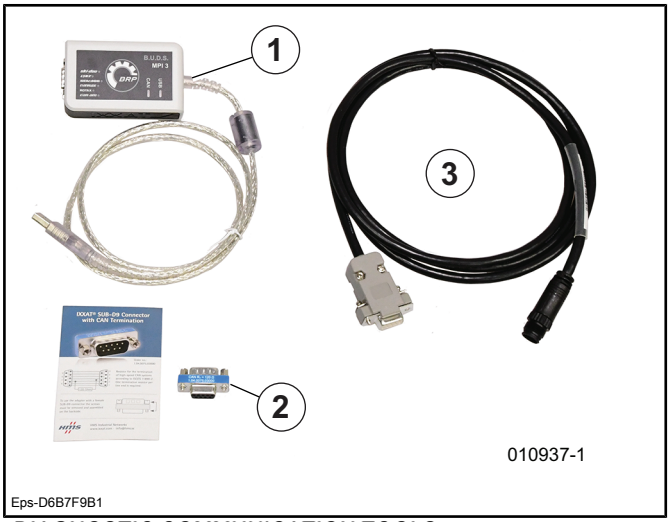
IMPORTANT: For software help, refer to the "Help" menu in the software.

Communication

Diagnostic Communication Tools

Evinrude E-TEC G2 models communicate diagnostic information over the *NMEA 2000* network. Diagnostic Tool Kit, P/N 766690, which includes an MPI–3 Adapter, P/N 767994, is required. Interface Cable, P/N 767431, is also required.

Note: The MPI–2, USB to CAN interface has been replaced. Dealers who use this tool kit with an MPI–2 interface should continue to use the MPI–2. Updating to an MPI–3 is NOT required. The MPI–3 version of the USB to CAN interface includes an IXXAT D– 9 CAN Termination Resistor/Adapter. Do **NOT** use this adapter for diagnostics with ANY *Evinrude* products. Use of the adapter with *Evinrude* products can cause erroneous readings.



DIAGNOSTIC COMMUNICATION TOOLS

1. *MPI-3 adapter*
2. *IXXAT D–9 CAN adapter (Do NOT use with Evinrude products)*
3. *Interface Cable, P/N 767431*

Connect the Interface Cable, P/N 767431 to the MPI adapter. Connect the *NMEA 2000* connector to a Tee, P/N 764151, in the *NMEA 2000* network.

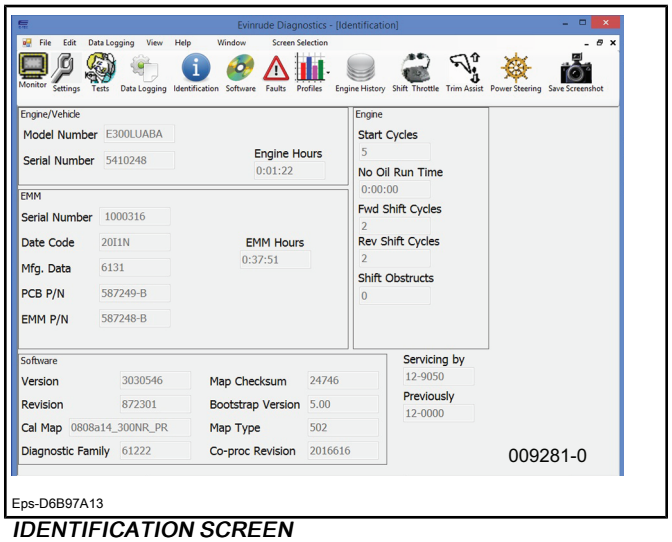
Connect the USB connector of the MPI adapter directly to the computer's USB port.

The *EMM* must turn ON before it will communicate with the computer.

Power is normally supplied to the *EMM* when the key switch is ON. Switched B+ (12 V) enters the *EMM* at pin 21 (purple/black) of the *EMM* J1-B connector.

Identification

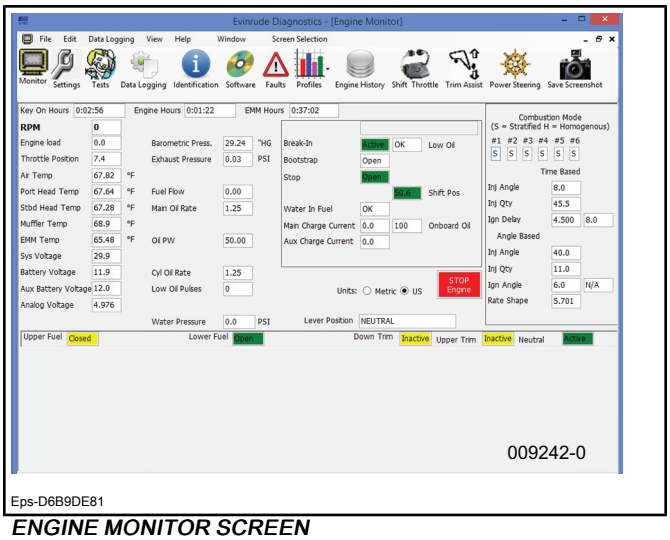
The *Identification* screen displays the engine model and serial numbers as well as other manufacturing information. The outboard model and serial numbers displayed on the Identification screen must match the *Identification* label on the outboard swivel bracket.



IDENTIFICATION SCREEN

Engine Monitor Information

The *Engine Monitor* screen displays dynamic information while the outboard is running. Changes in data, such as voltages or temperatures, are shown as they happen.



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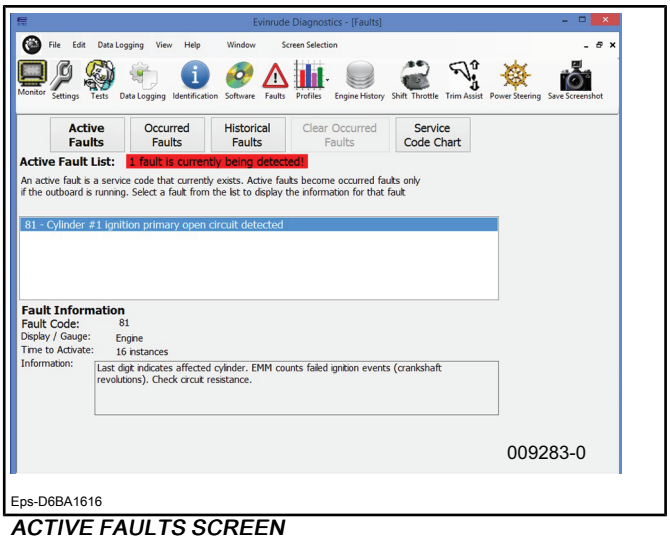
ENGINE MONITOR SCREEN



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ACTIVE FAULTS SCREEN

Faults and Fault Codes

An abnormal condition that occurs is known as a fault. There are three types of faults:

– *Active Fault* – A fault that currently exists. Active faults become occurred faults only if the outboard is running.
– *Occurred Fault* – A fault that occurred while the engine was running at some point in time.
– *Historical Fault* – An historical record of occurred faults. Historical faults cannot be cleared.

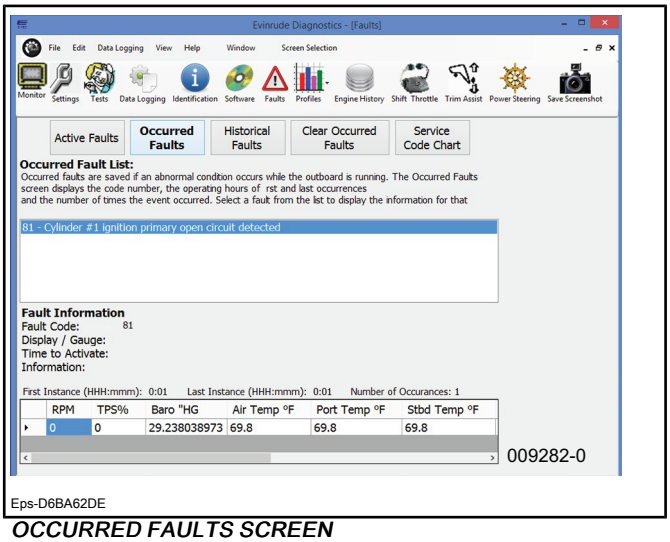
A fault code and corresponding fault code number are generated for monitored conditions. Refer to the **Fault Code Chart** for a complete list of all fault codes.

Active Faults

The Active Faults screen displays the code number, the number of times the event occurred, and number of occurrences.

Occurred Faults

The *Occurred Faults* screen displays the code number, the number of times the event occurred, and operating hours of first and last occurrences.



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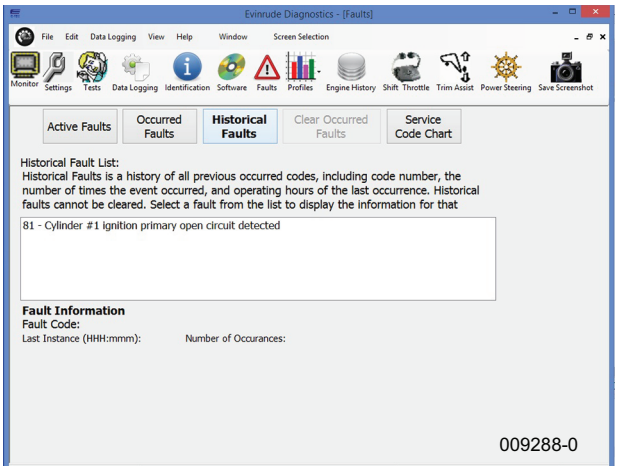
OCCURRED FAULTS SCREEN

Historical Faults

The Historical Faults screen displays a history of all previous occurred codes, including code number, the number of times the event occurred, and operating hours of the last occurrence.

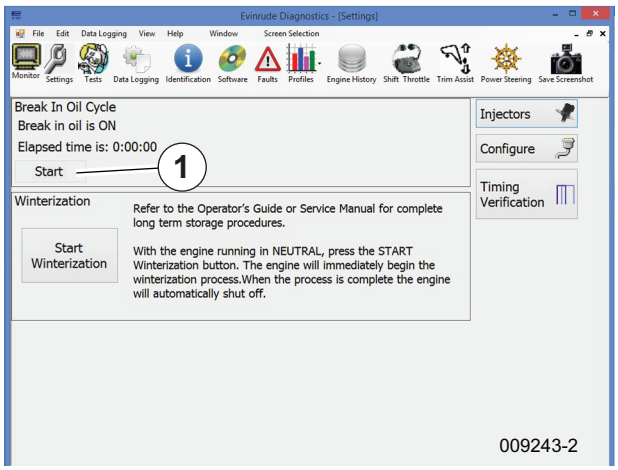


HISTORICAL FAULTS SCREEN

Settings

Powerhead Break-In

Use the diagnostic software to initiate break-in oiling. Break-in is a predetermined oiling program that runs for two hours of outboard operation, above 2000 RPM.



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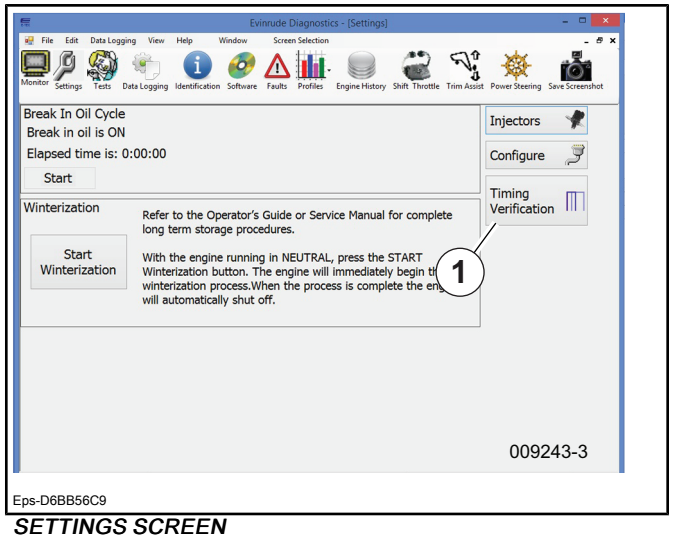
SETTINGS SCREEN

1. *Break-in oil START button*

Ignition Timing

Use the *Timing Verification* screen to check and adjust *EMM* timing. *EMM* timing must be synchronized to crankshaft position.

Refer to **Timing Adjustments**.



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SETTINGS SCREEN

1. *Timing Verification*

Check timing after replacing a powerhead, crankshaft or flywheel.

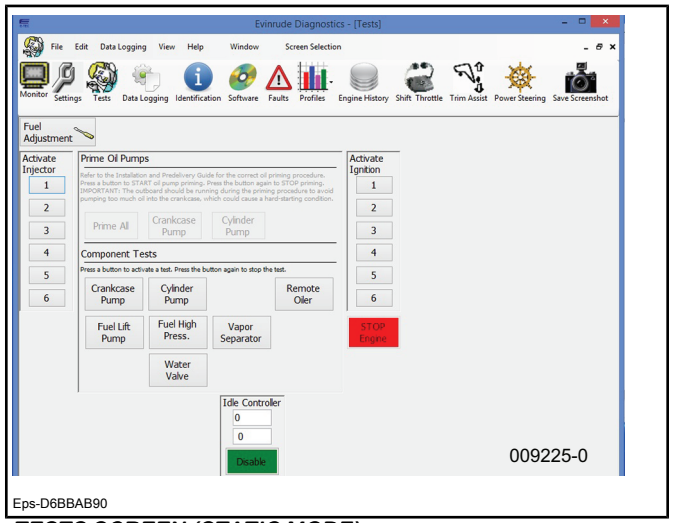
IMPORTANT: Make sure the timing pointer is set and the outboard reaches operating temperature before making adjustments.

Tests

The Tests screen displays both static and dynamic tests. The appropriate buttons are active depending on whether the outboard is running or not running.

Static Tests

Static Tests allow diagnostic testing of system components while the outboard is NOT running.



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TESTS SCREEN (STATIC MODE)

Ignition Test

Use the diagnostics software to test each ignition circuit. Refer to **Ignition System Static Test**.

Injector Test

Use the diagnostics software to test each fuel injector circuit. Refer to **Fuel Injector Static Test**.

Oil Pumps

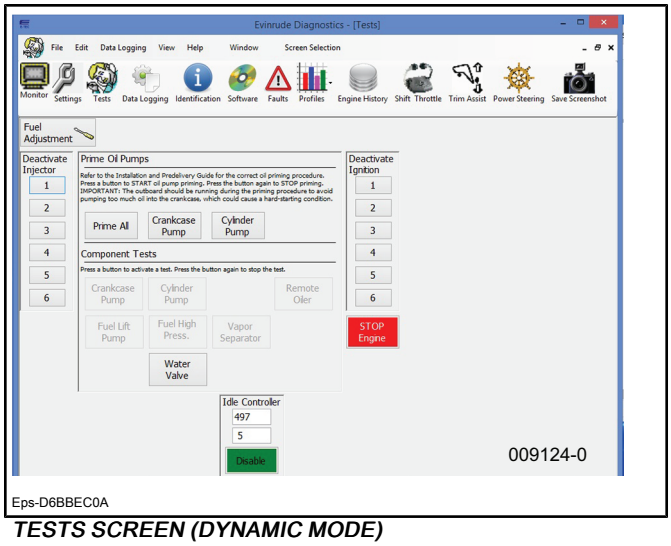
Use the diagnostics software to test the oil pump circuits. Refer to **Oiling System Tests**.

Fuel Pumps

Use the diagnostics software to test the fuel lift pump and fuel circulation pump circuits. Refer to **Fuel Pump Static Test**.

Dynamic Tests

Dynamic tests are performed with the outboard running.



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TESTS SCREEN (DYNAMIC MODE)

Ignition Test

This test momentarily disables the ignition and fuel injection circuits to one cylinder. By dropping one cylinder, RPM and running quality changes can be observed. Refer to **Dynamic Tests**.

Injector Test

This test momentarily disables one fuel injector circuit. By dropping one cylinder, RPM and running quality changes can be observed. Refer to **Dynamic Tests**.

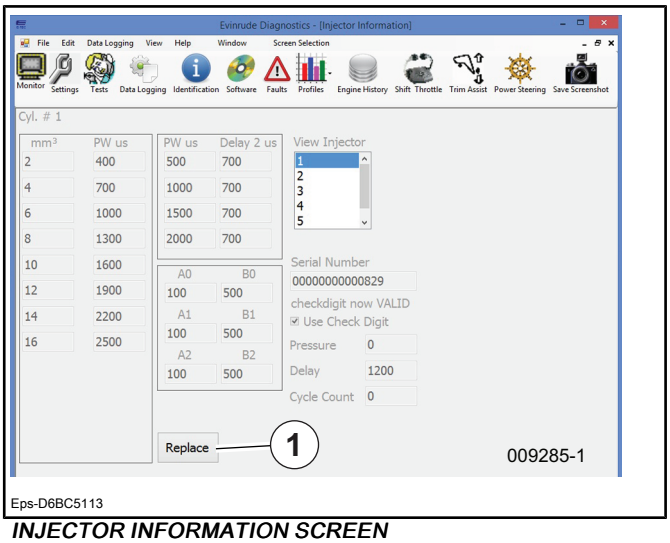
Prime Oil

This test is used to cycle the oil injection pump for priming the oiling system. Perform this test with outboard running to activate oil pump.

Fuel Injector Servicing

All *E-TEC* fuel injectors use software programming to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the *EMM*. DO NOT install an injector without updating the compensation software.

To install a service injector, click the “Replace” button on the Injector Information screen and select the file for the replacement injector. Refer to **Fuel Injector Service**.



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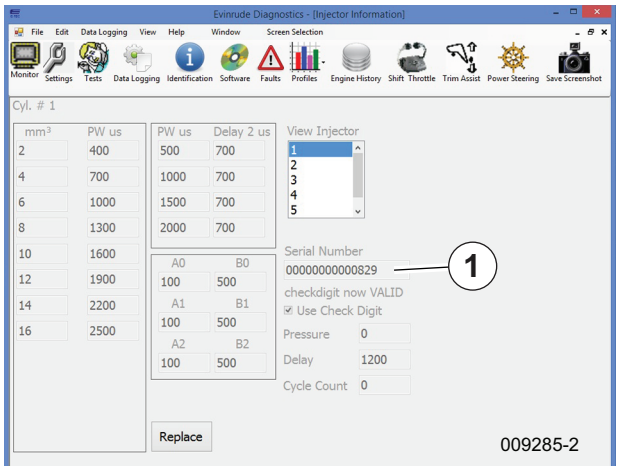
INJECTOR INFORMATION SCREEN

1. Replace button

The serial number and cylinder location displayed on the *Injector Coefficients* screen must match the actual cylinder placement for each injector.



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INJECTOR INFORMATION SCREEN

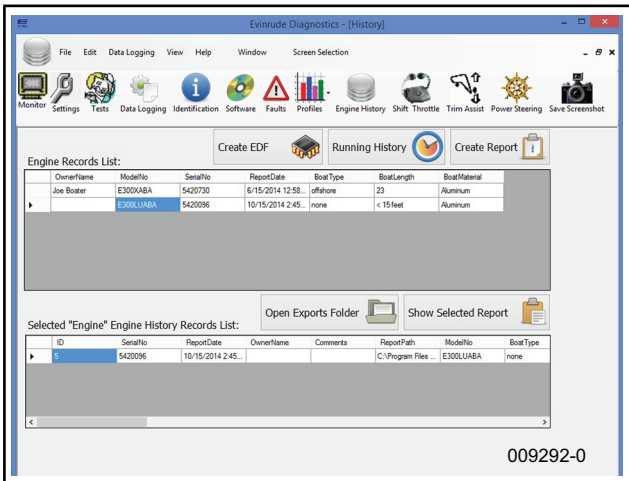
1. Injector serial number

History and Reports

Engine history and reports provide service records and can be used to document the running history of an outboard. Reviewing this information can help identify or resolve some service issues.

From the history screen:

- Press the *Create EDF* button to create an engine data file. Engine data files are required when replacing an *EMM*.
- Press the *Running History* button to view the *Last Two Minutes* data.
- Press the *Create Report* button to create a new report (must be connected to/communicating with the engine *EMM*).
- Press *Open Exports Folder* to view saved reports.
- Press *Show Selected Report* to view a report selected from the Engine History Records List.



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HISTORY SCREEN

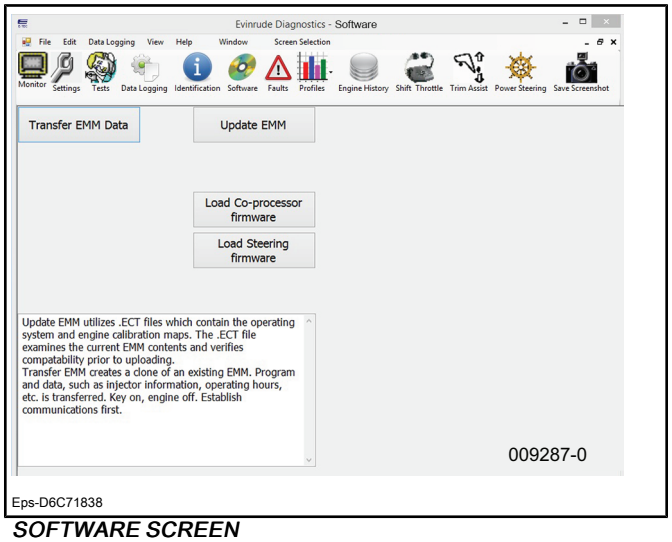
Software

Various management software is loaded into the *EMM* at the factory.

Periodically, a new program may be available to enhance the operation of an outboard. Select from:

- Update *EMM* to update engine management software
- Load Co-processor firmware to update the *EMM* co-processor
- Load *Steering firmware* to update a DPS module
- *EMM* Transfer to save and transfer engine history data when the *EMM* must be replaced

Follow the instructions provided with the program.



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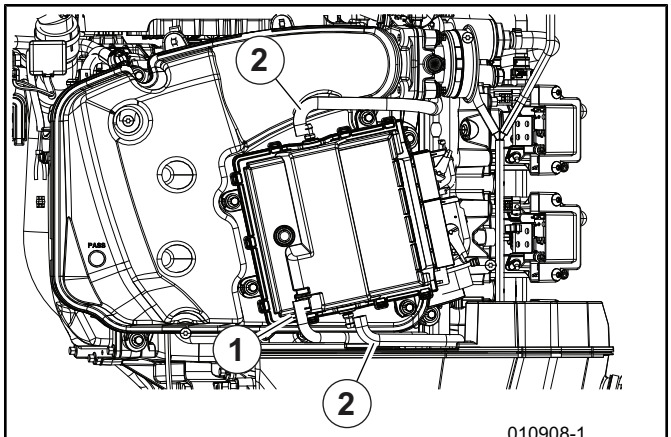
SOFTWARE SCREEN

EMM Servicing

IMPORTANT: If a new *EMM* is being installed, refer to **Software**.

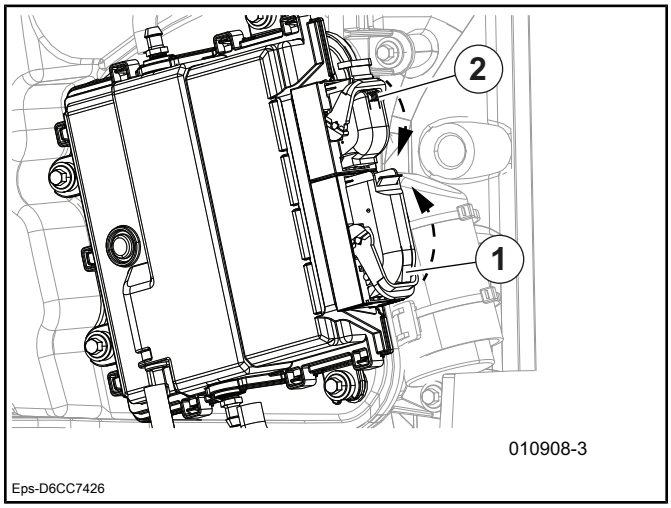
EMM Removal

1. Remove the engine covers and both frames. Refer to **Engine Cover and Frame Service**.
2. Disconnect the exhaust pressure hose and cooling water hoses from the *EMM*.



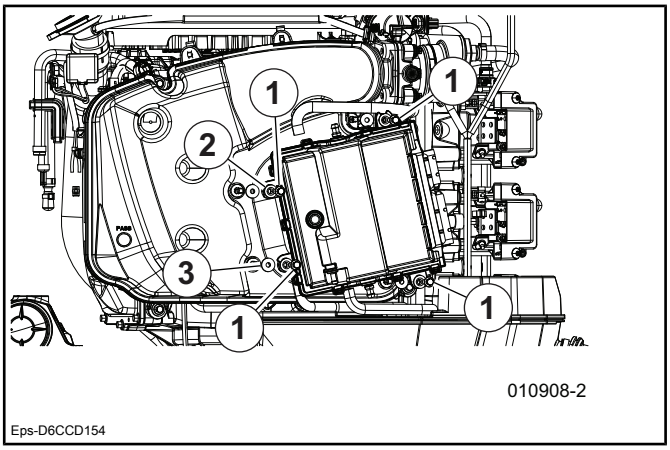
1. *Exhaust pressure hose*
2. *Cooling water hoses*

3. Disconnect the J1 connector from the *EMM* first. Press the lock release and rotate the lever up. Then remove the J1 Connector. Disconnect the J2 connector from the *EMM*. Press the lock release and rotate the lever down. Then remove the J2 Connector.



1. *J1 lock release*
2. *J2 lock release*

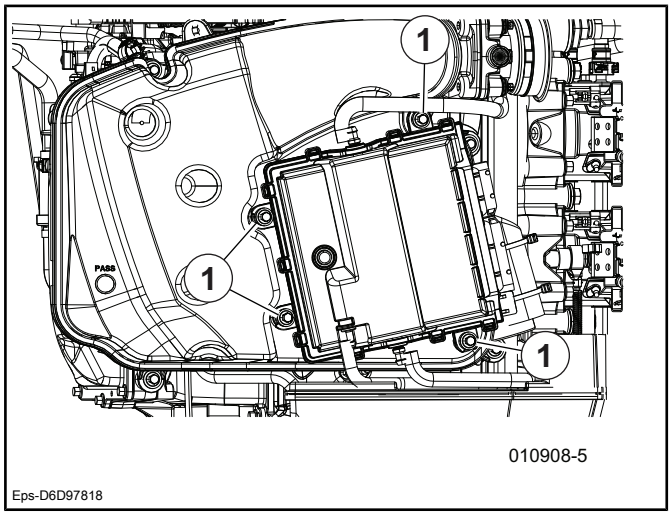
4. Remove the four*EMM* mounting screws and remove the *EMM* from the air box assembly. Be sure to save the isolators and flanged spacers and washers for re-use if replacing the *EMM*.



1. *Four screws*
2. *Isolators and flanged spacers*
3. *Washers*

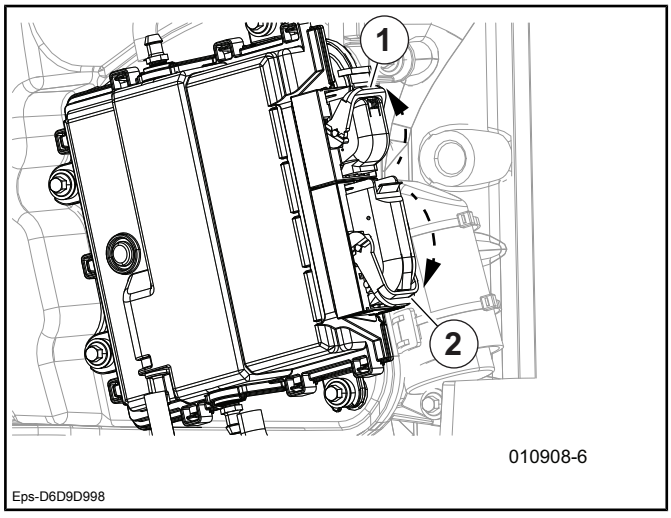
EMM Installation

1. If removed, install the isolators and flanged spacers on the *EMM* case.
2. Position the *EMM* onto the air box assembly. Secure the EMM with four washers and screws. Tighten screws to a torque of 24 to 35 In. lbs. (2.7 to 3.9 N·m).



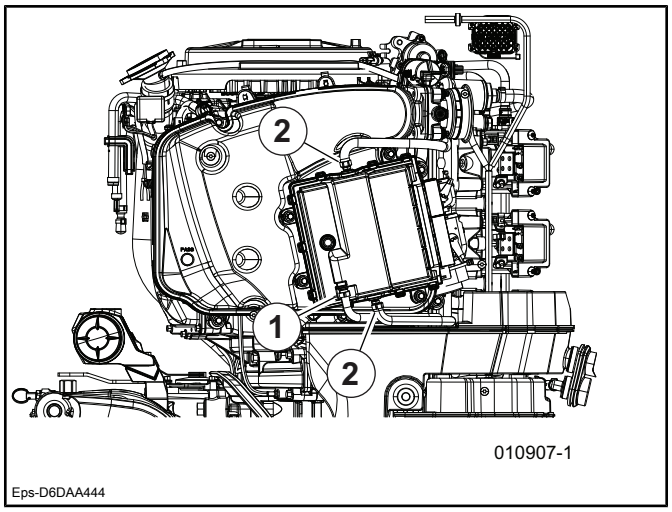
1. Four screws

3. Connect the J2 connector to the *EMM* first. Rotate the lever up, ensuring the lever is secured by the lock. Next, connect the J2 connector to the *EMM*. Rotate the lever down, ensuring the lever is secured by the lock.



1. J2 connector lever
2. J1 connector lever

4. Install the exhaust pressure hose and the water cooling hoses. Secure each hose with one 15.7 mm *Oetiker* clamp, P/N 346786.



1. Exhaust pressure hose
2. Cooling water hoses

5. Install the engine covers and frames. Refer to **Engine Cover and Frame Service**.

Notes

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

System Analysis

Diagnostic Procedures

Visual Inspections

Inspect the wiring and electrical connections. Disassemble and clean corroded connections. Replace damaged wiring, connectors or terminals. Repair any shorted electrical circuits.

– Refer to **Electrical Harness Connections**.
– Refer to the Wiring Diagram at the back of this manual.
– Refer to **Connector Servicing**.

Make sure all ground connections are clean and tight. Refer to **Ground Circuits**.

Inspect spark plugs for wear, oil fouling, or damage. A rich or lean running condition or evidence of internal engine damage could be identified by the appearance of the spark plugs.

Check the fuses and the emergency stop switch lanyard.

Diagnostic Software Inspections

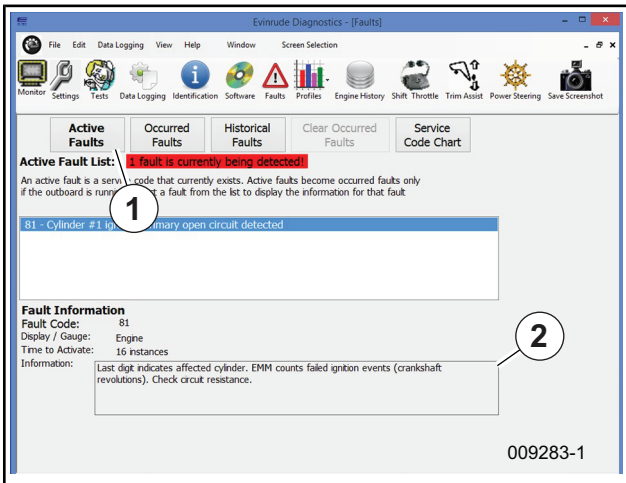
Before running the outboard, use *Evinrude Diagnostics* software v 6.4 or higher to review information saved in the *EMM*.

Correct any problems and clear any fault codes before further troubleshooting.

Faults

Check the Faults Screen. Press the Active Faults button to view existing faults.

The Active Faults screen displays fault codes that currently exist. An active fault becomes an occurred fault only if the outboard is running.



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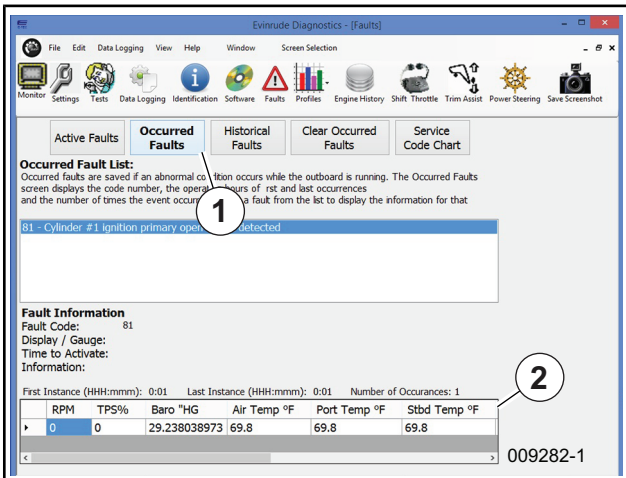
ACTIVE FAULTS SCREEN

1. *Active Faults button*
2. *Information*

Press the *Occurred Faults* button to view detailed information about the operating conditions of the engine at the time the fault code was set.



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OCCURRED FAULTS SCREEN

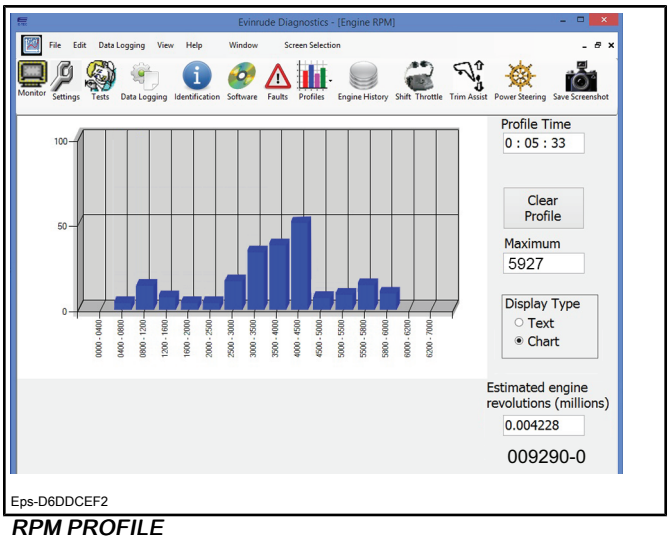
1. *Occurred Faults button*
2. *Detailed Information*

Profiles

Review information about how the outboard has been operated using the *Profiles* screens.

– Check the *RPM Profile* for long periods of low speed operation or periods of over-revving RPM.

5



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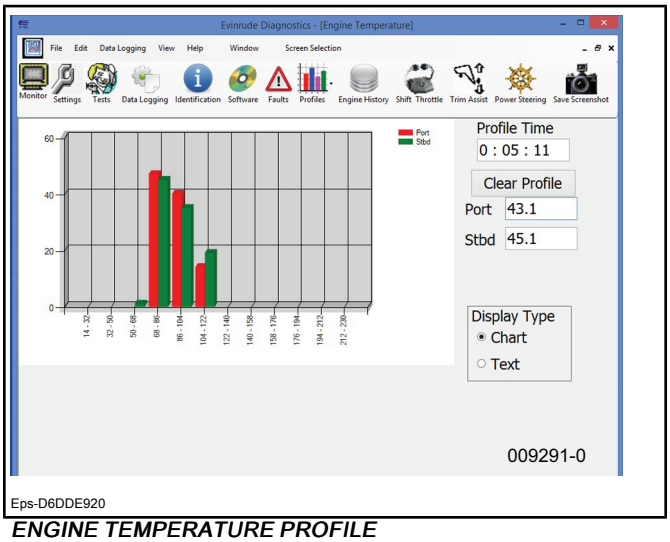
RPM PROFILE

– Check the *Engine Temperature Profile* for evidence of cold running or overheating.



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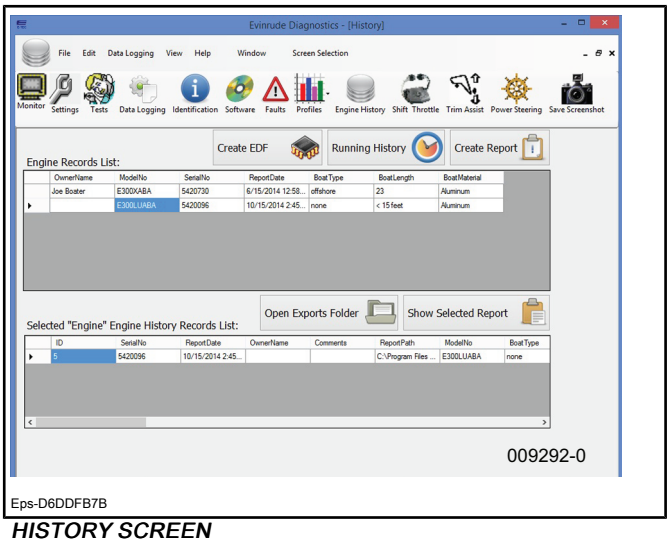
ENGINE TEMPERATURE PROFILE

History and Reports

View engine history and save reports from the History screen. Reports save a snapshot of current engine and sensor conditions.

From the *History* screen:

– Press the *Create EDF* button to create an engine data file. Engine data files are required when replacing an *EMM*.
– Press the *Running History* button to view the *Last Two Minutes* of engine run history.
– Press the *Create Report* button to create a new report (must be connected to/communicating with the engine *EMM*).
– Press *Open Exports Folder* to view saved reports.
– Press *Show Selected Report* to view a report selected from the Engine History Records List.



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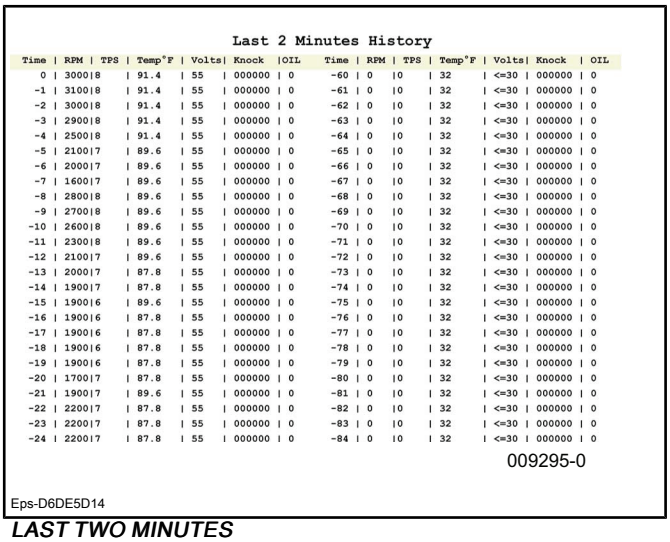
HISTORY SCREEN

– The *Last Two Minutes* report is generated and saved as part of the Engine Report. Engine run-time values during the last two minutes of operation above 1500 rpm is collected once per second. The newest record is first on the list. As each new record is added, the oldest record is removed.



Last 2 Minutes History

Time	RPM	TPS	Temp°F	Volts	Knock	OIL	Time	RPM	TPS	Temp°F	Volts	Knock	OIL
0	3000	8	91.4	55	000000	0	-60	0	0	32	<=30	000000	0
-1	3100	8	91.4	55	000000	0	-61	0	0	32	<=30	000000	0
-2	3000	8	91.4	55	000000	0	-62	0	0	32	<=30	000000	0
-3	2900	8	91.4	55	000000	0	-63	0	0	32	<=30	000000	0
-4	2500	8	91.4	55	000000	0	-64	0	0	32	<=30	000000	0
-5	2100	7	89.6	55	000000	0	-65	0	0	32	<=30	000000	0
-6	2000	7	89.6	55	000000	0	-66	0	0	32	<=30	000000	0
-7	1600	7	89.6	55	000000	0	-67	0	0	32	<=30	000000	0
-8	2800	8	89.6	55	000000	0	-68	0	0	32	<=30	000000	0
-9	2700	8	89.6	55	000000	0	-69	0	0	32	<=30	000000	0
-10	2600	8	89.6	55	000000	0	-70	0	0	32	<=30	000000	0
-11	2300	8	89.6	55	000000	0	-71	0	0	32	<=30	000000	0
-12	2100	7	89.6	55	000000	0	-72	0	0	32	<=30	000000	0
-13	2000	7	87.8	55	000000	0	-73	0	0	32	<=30	000000	0
-14	1900	7	87.8	55	000000	0	-74	0	0	32	<=30	000000	0
-15	1900	6	89.6	55	000000	0	-75	0	0	32	<=30	000000	0
-16	1900	6	87.8	55	000000	0	-76	0	0	32	<=30	000000	0
-17	1900	6	87.8	55	000000	0	-77	0	0	32	<=30	000000	0
-18	1900	6	87.8	55	000000	0	-78	0	0	32	<=30	000000	0
-19	1900	6	87.8	55	000000	0	-79	0	0	32	<=30	000000	0
-20	1700	7	87.8	55	000000	0	-80	0	0	32	<=30	000000	0
-21	1900	7	89.6	55	000000	0	-81	0	0	32	<=30	000000	0
-22	2200	7	87.8	55	000000	0	-82	0	0	32	<=30	000000	0
-23	2200	7	87.8	55	000000	0	-83	0	0	32	<=30	000000	0
-24	2200	7	87.8	55	000000	0	-84	0	0	32	<=30	000000	0

009295-0

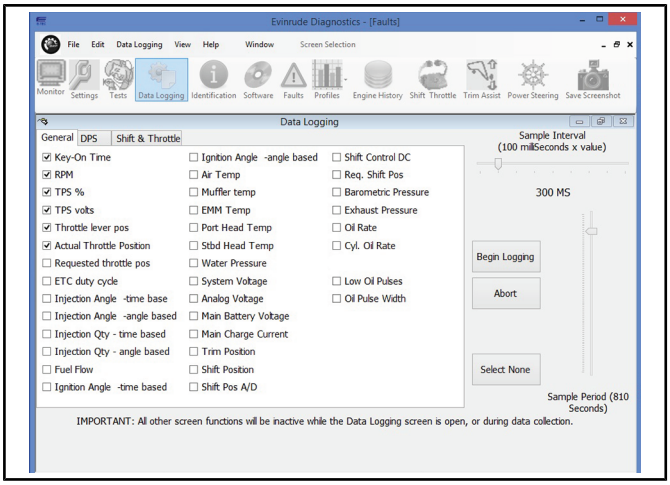
Eps-D6DE5D14

LAST TWO MINUTES

Data Logging

Run the outboard in the water at all speeds. Be sure to run at any report problem engine speeds to confirm actual symptoms. Inspection should include the following:

– Use the diagnostics software *Logging* function to record engine data as a problem is occurring.



LOGGING SCREEN

Operational Inspections

Run the outboard to confirm actual symptoms before performing any unnecessary procedures.

Inspection should include the following:

– Make sure the outboard can be cranked easily, with no mechanical binding.

Troubleshooting

Outboard will not crank, starter does not operate:

– Check condition of battery and cables (main battery switch and cables). Make sure battery cables are not reversed.
– Confirm that switched B+ is present at “A” terminal (purple wire) of starter solenoid with key switch in the ON position.
– Refer to **Electric Starter Tests**. Repair starter or start circuit as needed.

Outboard cranks, will not start:

– Check emergency stop switch and lanyard
– Use the *Evinrude Diagnostics* software *Faults* screens to check for current fault codes. If there are multiple occurred sensor codes, inspect all 5 V sensor circuits for broken or grounded wiring.
– Perform a Static Ignition test using *Evinrude Diagnostics* software and an inductive timing light. Refer to **Ignition System Static Test**.
– If ignition test indicates steady spark.

Outboard runs, low on power, misfires

– Use the *Evinrude Diagnostics* software Monitor screen to check system (55 V) and TPS voltages. System voltage should be steady, and TPS voltage should be between 0.2 and 4.85 V.

IMPORTANT: Use a digital multimeter to check voltage on external circuits only when necessary. All *EMM* output currents are DC current.

– Use the diagnostics software Dynamic Tests to isolate a faulty cylinder. See **Dynamic Tests**.
– Use an inductive timing light to check ignition and fuel injector circuits. Refer to **Running Ignition Tests** and **Running Fuel System Tests**.
– Use the diagnostics software Fuel Control Adjustment test to help identify a cylinder that may be too rich or too lean. Refer to **Fuel Control Adjustment**.
– Use an inductive amp meter to monitor injector circuit current. Compare readings of all circuits to identify possible failure.
– Check fuel quality and that fuel is present at injectors.
– AFTER all the above inspections, if the cause of a running quality problem still cannot be identified, perform a compression test to check for internal powerhead damage.

IMPORTANT: Remove a cylinder head or disassemble the engine only as a last resort.

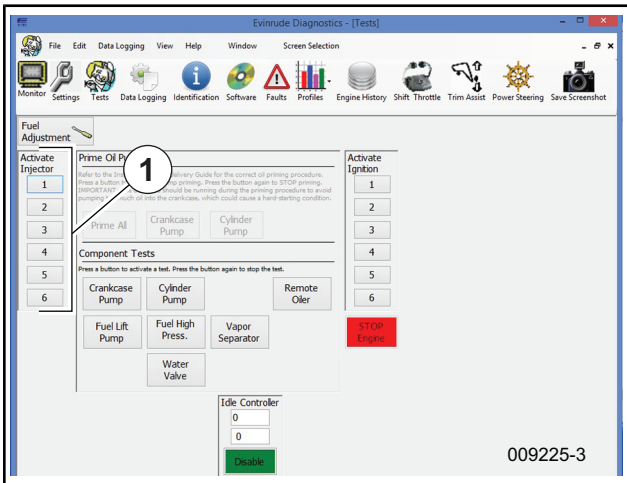
Static Tests

Ignition System Static Test

Perform the static ignition test using *Evinrude Diagnostics* software and an inductive timing light.

IMPORTANT: DO NOT use a spark checker tool. Radio Frequency Interference (RFI) generated by the arcing current can cause erratic EMM operation.

The outboard must NOT be running and the emergency stop switch lanyard must be installed.



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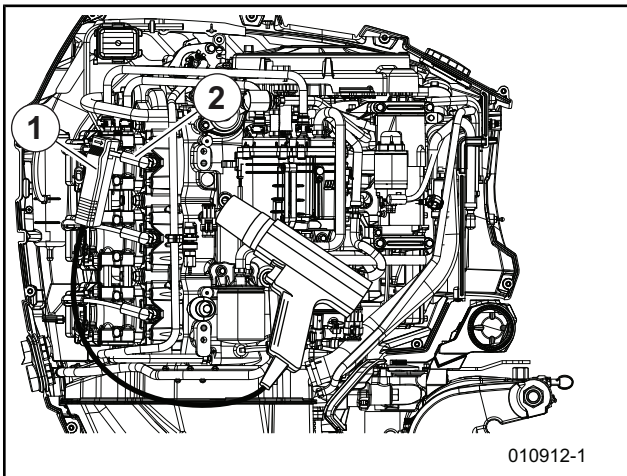
TESTING, STATIC TESTS SCREEN

Connect timing light pickup to the secondary circuit (spark plug lead) of the cylinder being tested. Activate test and observe timing light strobe for consistent flash.

IMPORTANT: You may need to remove shielding from wire if pickup does not read signal.



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1. *Timing light pick-up*
2. *Spark plug lead*

No spark on one or more cylinders:

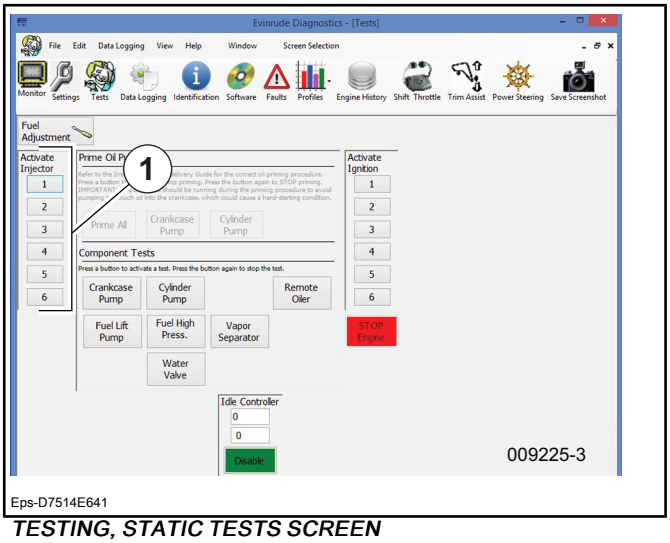
- Inspect or replace spark plugs
- Refer to **Ignition Circuit Tests**
- Refer to **Ignition Coil Tests**

Steady spark on all cylinders:

- Refer to **Running Ignition Tests** and **Dynamic Tests**

Fuel Pump Static Tests

Use the *Evinrude Diagnostics* software Fuel Pump test to activate the electric fuel pump. If the pump runs, the *EMM* and fuel pump circuit are not at fault.



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TESTING, STATIC TESTS SCREEN

If the pump does not run:

- The *EMM* controls power to the fuel pump (purple/black wire). Check voltage at pin 1 of fuel pump connector. Voltage should be 12 V when KEY is first ON, when fuel pump test activated, or when outboard is cranking or running.
- Use an ohmmeter to check continuity between pin 2 of fuel pump connector and ground
- Refer to **Fuel Circulation Pump Resistance Test**
-

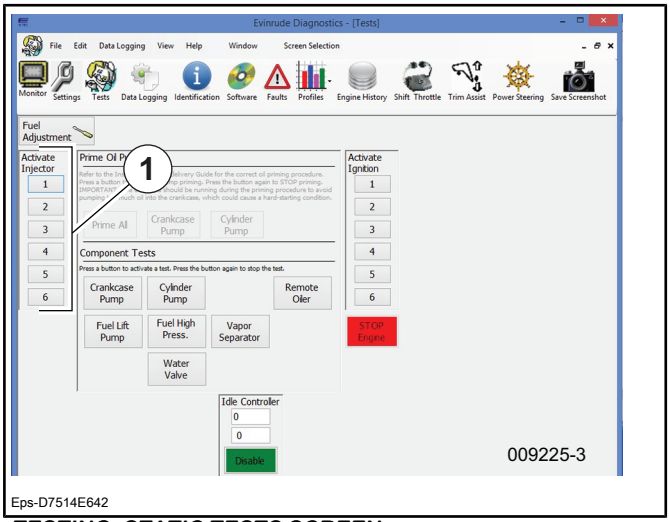
If the pump runs:

- Refer to **Fuel System Pressure Tests**
- Refer to **Running Fuel System Tests**.

Fuel Injector Static Test

Use the *Evinrude Diagnostics* software Fuel Injector Static Test to activate each fuel injector. Listen for an audible click from each injector when it is

actuated. If the injector activates, the *EMM* and injector circuits are not at fault.



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TESTING, STATIC TESTS SCREEN

IMPORTANT: This test is operating the injectors with 30 V on the system voltage (55 V) circuit. The start assist circuit (SAC) of the *EMM* converts battery voltage (12 V) to 30 V of system voltage. Battery must be fully charged and connections must be clean and tight. Injector activation should be carefully confirmed.

No Injectors Actuate:

- Use the *Monitor* screen of the diagnostics software to make sure voltage is present on the system voltage circuit.
- Refer to **Running Fuel System Tests**.

Some Injectors Actuate:

- For non-working injectors, test the resistance of individual injector circuits between the injector connector and injector control wire at the *EMM*.
- Refer to **Fuel Injector Resistance Test**.

All Injectors Actuate:

- Refer to **Running Fuel System Tests**.

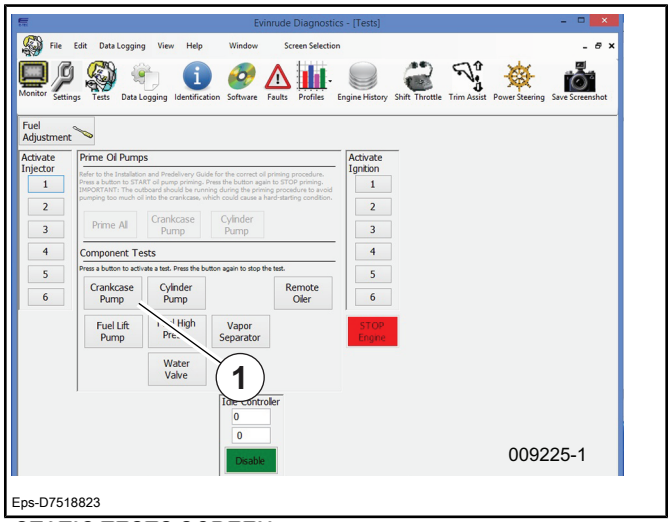
Oil Pump Static Test

IMPORTANT: Static tests operate the oil pump (s) with 30 V on the system voltage (55 V) circuit. The start assist circuit (SAC) of the *EMM* converts battery voltage (12 V) to 30 V of system voltage. The battery MUST be fully charged and connections must be clean and tight.

Oil pump activation should be carefully confirmed. Listen for an audible click from the oil pump when it is activated.

The *EMM* controls the pump by providing ground through pin 87 (blue wire) of the J2 connector and pin B (blue wire) of the oil pump connector.

Use the *Crankcase Pump* test of *Evinrude Diagnostic* software *Tests* screen to activate the oil pump. This test activates the *EMM* control function for the oil pump.



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STATIC TESTS SCREEN

1. Oil Pump button

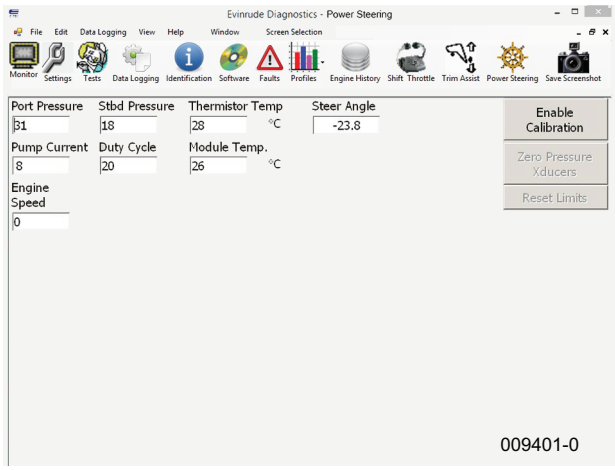
Use an inductive timing light to monitor current flow through the ground circuit (blue wire) at the oil pump connector (pin B).

- If the light flashes, the *EMM* and oil pump circuits are not at fault.
- If the light does not flash, refer to **Oil Pump Electrical Tests**.

Dynamic Power Steering (DPS)

Use the Power Steering screen of *Evinrude Diagnostics* software to observe DPS system reactions while turning the steering wheel.

5



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POWER STEERING SCREEN

Dynamic Tests

Cylinder Drop Tests

Use the *Evinrude Diagnostics* software *Dynamic Tests* to momentarily disable one cylinder while the outboard is running.

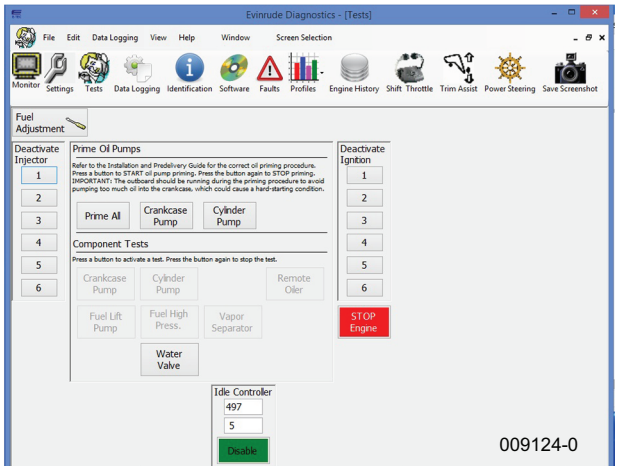
- The Dynamic Ignition test disables the ignition and fuel injection circuits to a cylinder
- The Dynamic Fuel test momentarily disables one fuel injection circuit

By dropping one cylinder, RPM and running quality changes can be compared for each cylinder.

IMPORTANT: Test the outboard at the RPM where the problem is occurring. Use the test procedures to identify inconsistencies in voltages and cylinder performance. Once a circuit has been identified as malfunctioning, inspect all related wiring and connections. Check all voltage inputs and grounds; and perform resistance tests for all circuits before replacing any suspect components.

Dynamic Tests can be used with:

- A timing light to determine how other cylinder are affected by one cylinder being “dropped”, or
- A digital multimeter to check voltage changes on electrical circuits



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DYNAMIC TESTS SCREEN

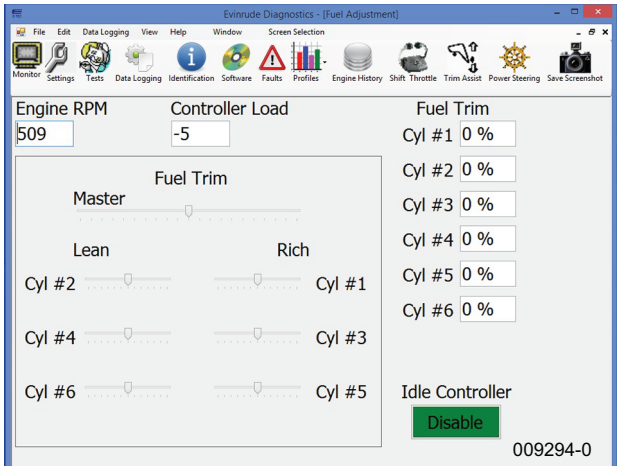
IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the *EMM* compensates to maintain a constant IDLE speed. The Dynamic Tests screen includes a function to temporarily disable the idle controller.

Fuel Control Adjustment

Use this test is to help identify a cylinder that may be too rich or too lean. This feature should not be used by itself to identify a faulty injector.

Evinrude Diagnostics software allows temporary adjustments to the fuel flow characteristics of the injectors. Factory fuel flow settings are restored when power to the *EMM* is returned to OFF.

Test the outboard at the RPM where the problem is occurring.



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FUEL CONTROL SCREEN

If the outboard run quality improves with a fuel control adjustment, eliminate other possibilities before replacing an injector:

- Refer to **Fuel System Tests**.
- Refer to **Running Fuel System Tests**.

IMPORTANT: DO NOT misinterpret tests run at IDLE. The idle speed controller in the *EMM* compensates to maintain a constant IDLE speed.

Notes

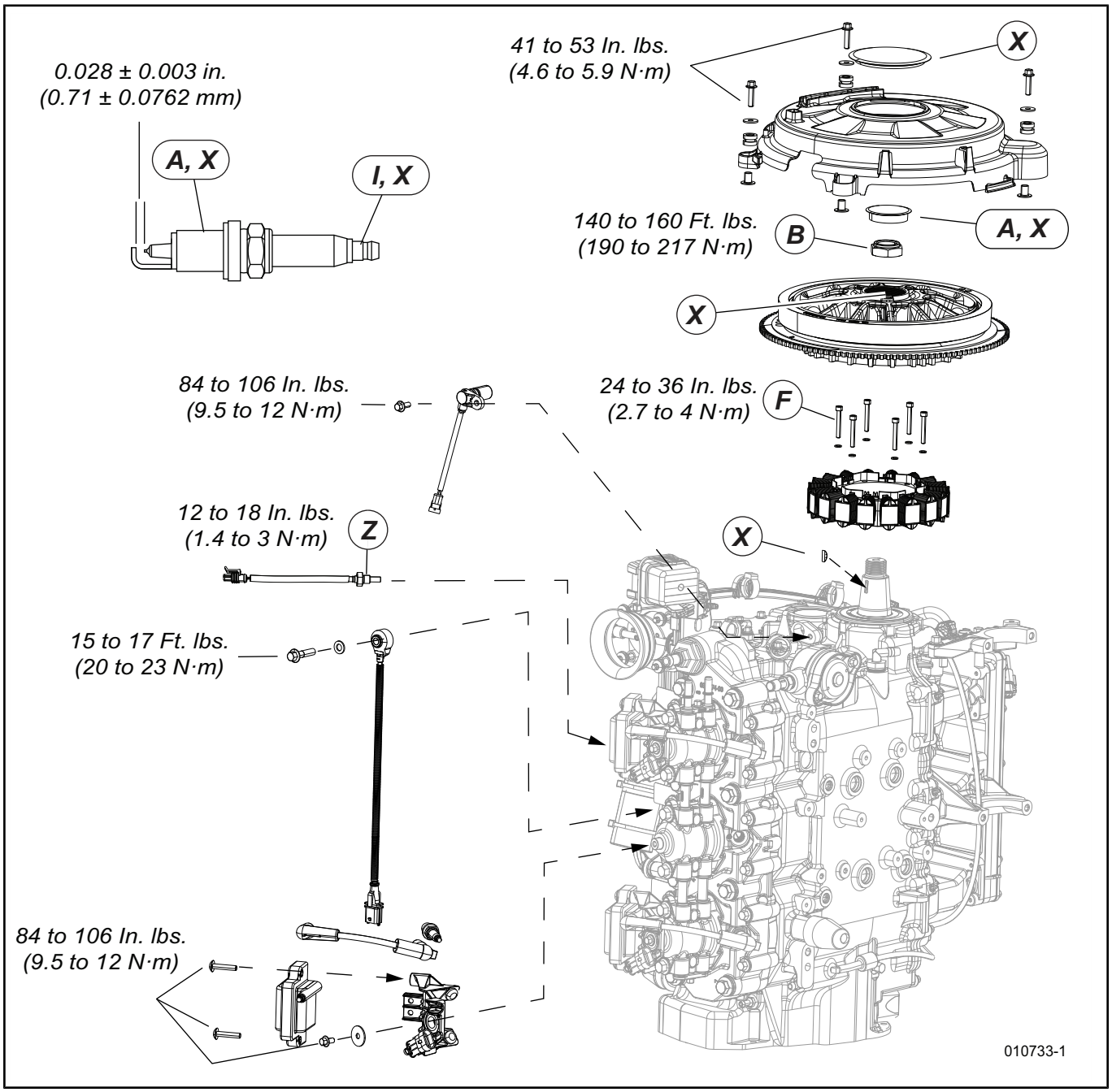
Technician's Notes

Related Documents

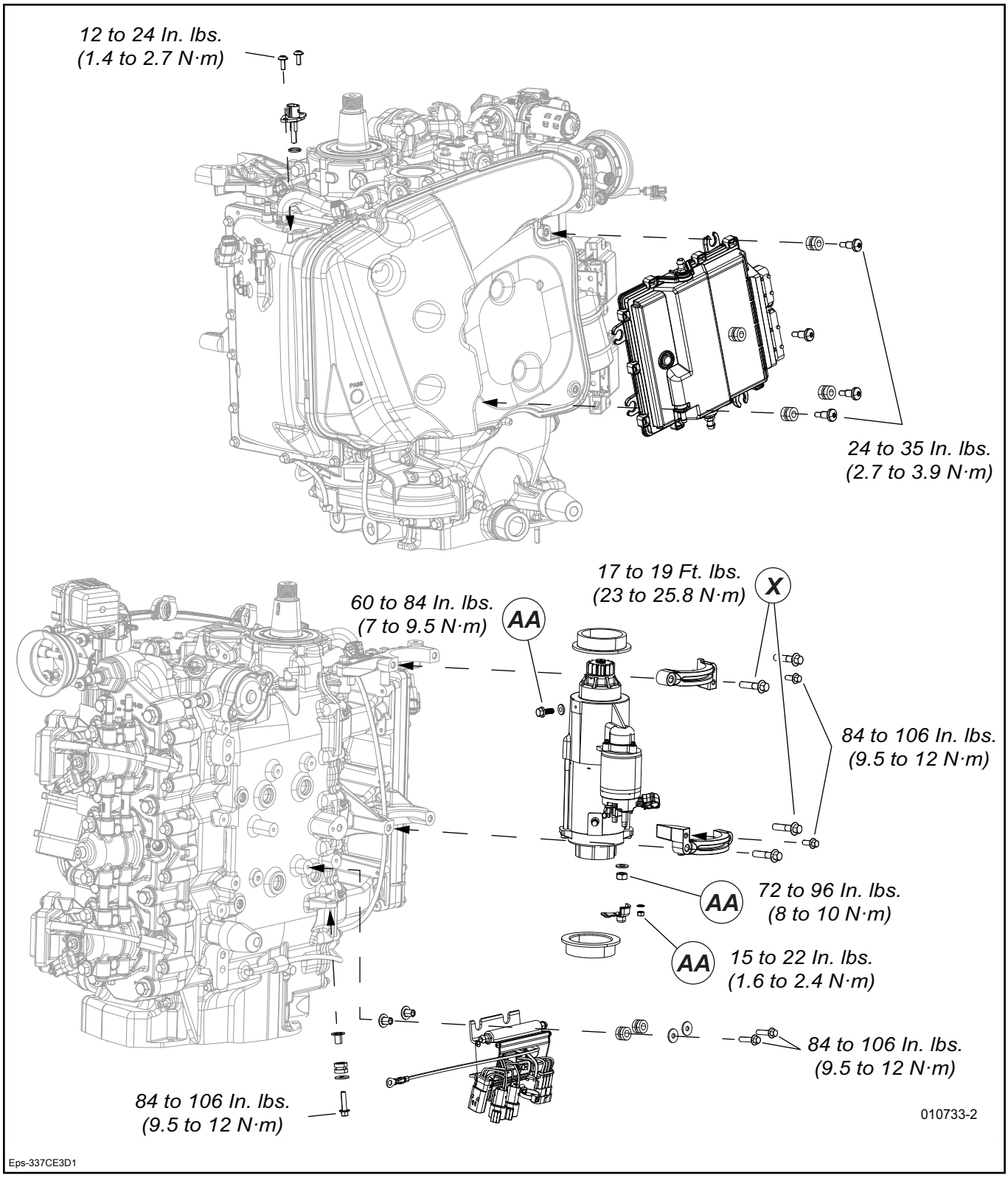
Bulletins	
Instruction Sheets	
Other	

Electrical and Ignition

Service Charts: Electrical and Ignition

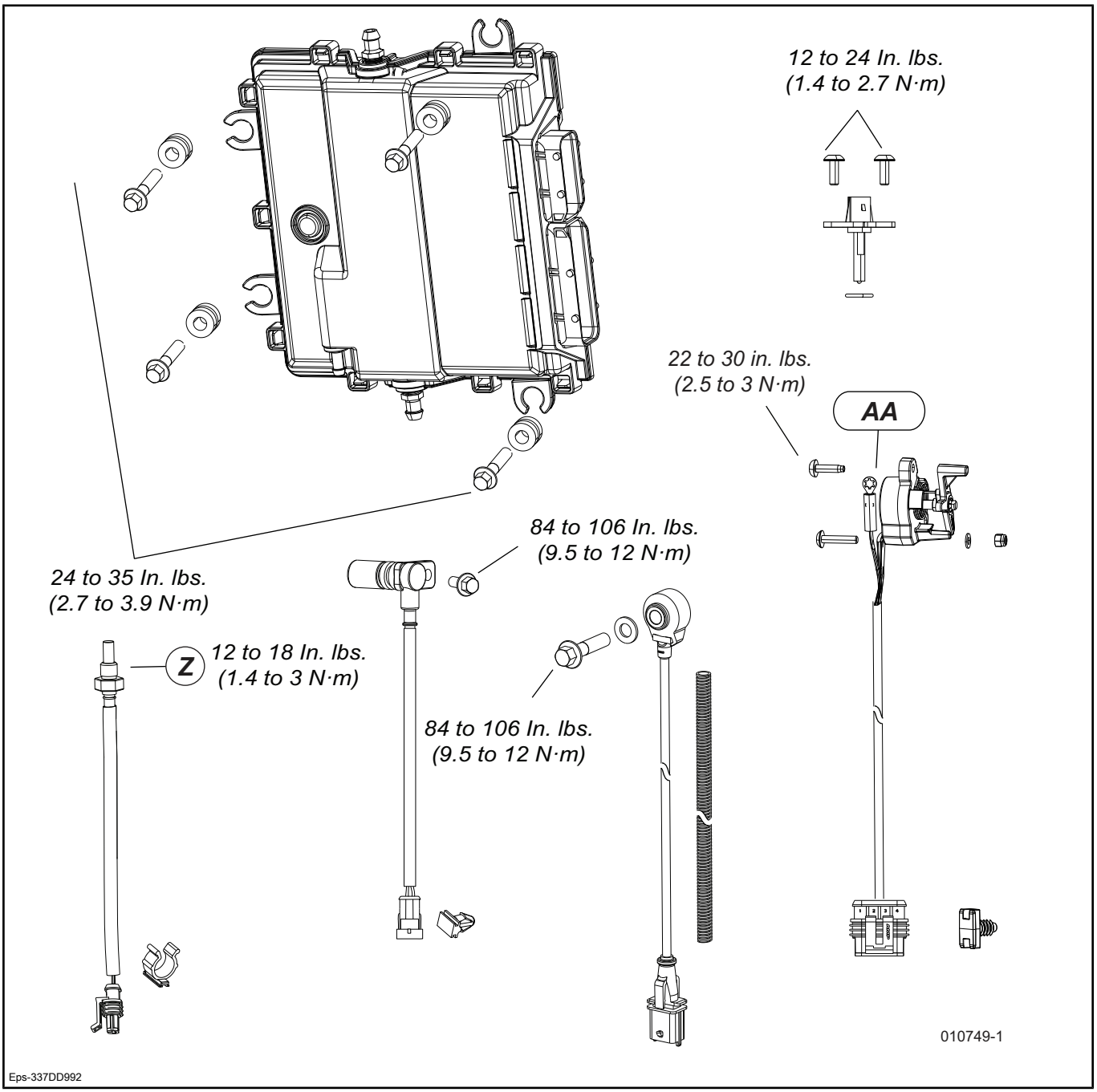


A	*Triple Guard* grease	***B***	Gasket Sealing Compound
F	Nut Lock	***I***	Dielectric grease
X	See Service Manual procedure	***Z***	Thermal Joint Compound

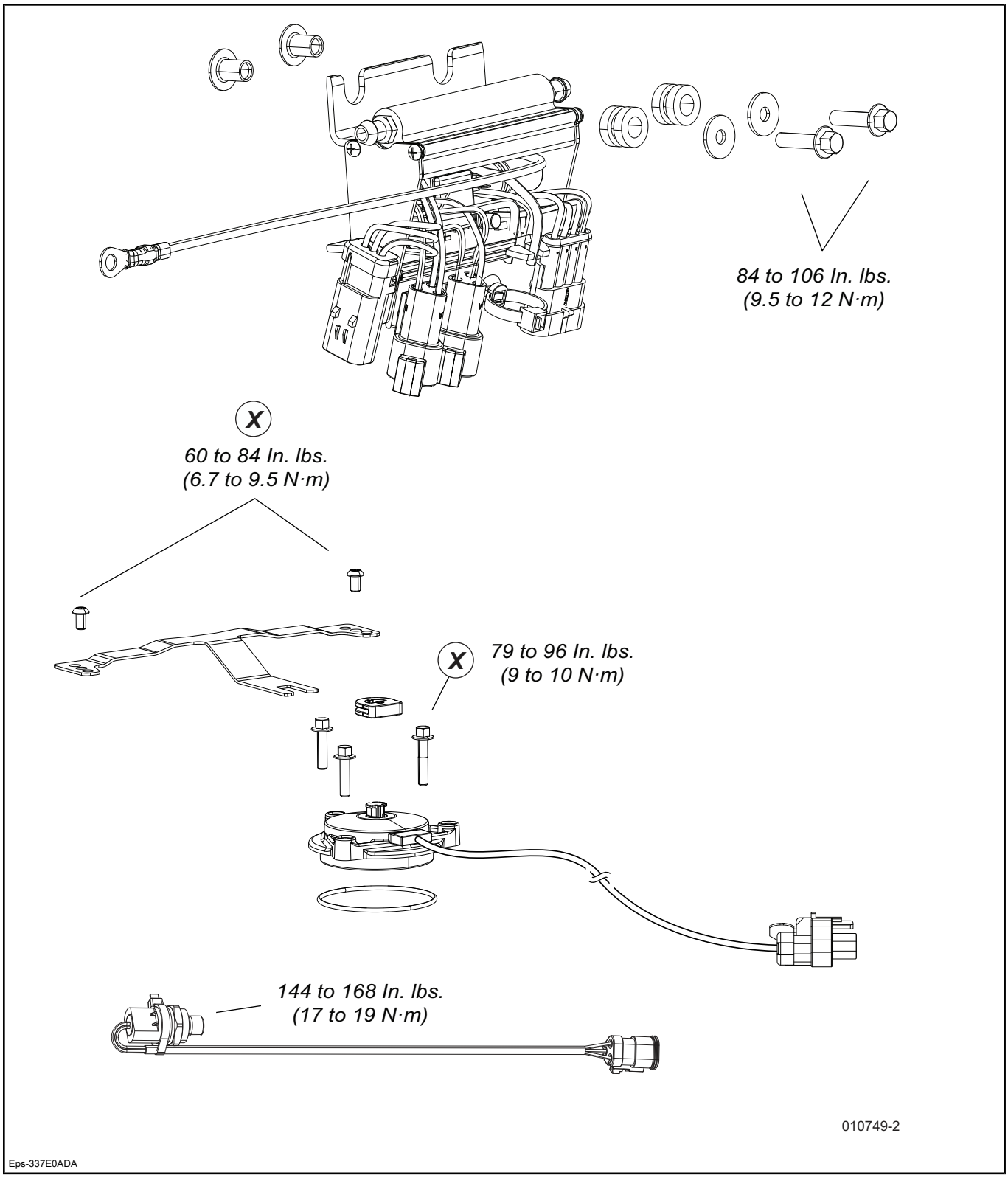


AA	No-Ox grease	***X***	See Service Manual procedure

Service Charts: Modules and Sensors



X	See Service Manual procedure	***Z***	Thermal Joint Compound
AA	No-Ox grease		



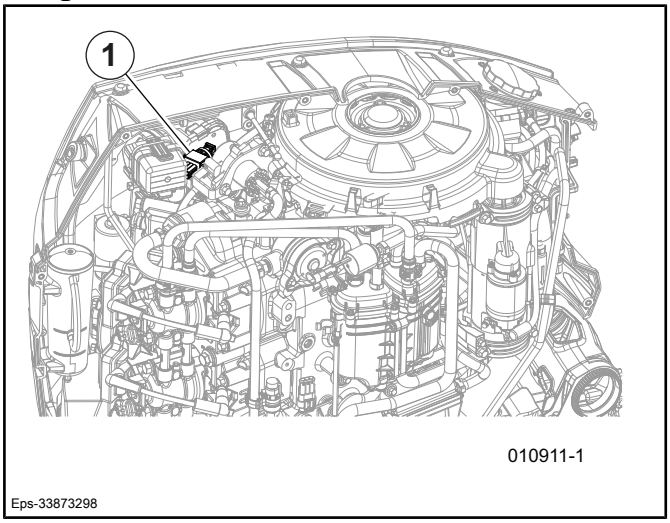
X	See Service Manual procedure

Electrical Harness Connections

Inspect wiring and electrical connections. Disassemble and clean all corroded connections. Replace damaged wiring, connectors, or terminals. Repair any shorted electrical circuits. Refer to wiring diagrams and reference charts for specific wiring details.

Refer to **Connector Servicing**.

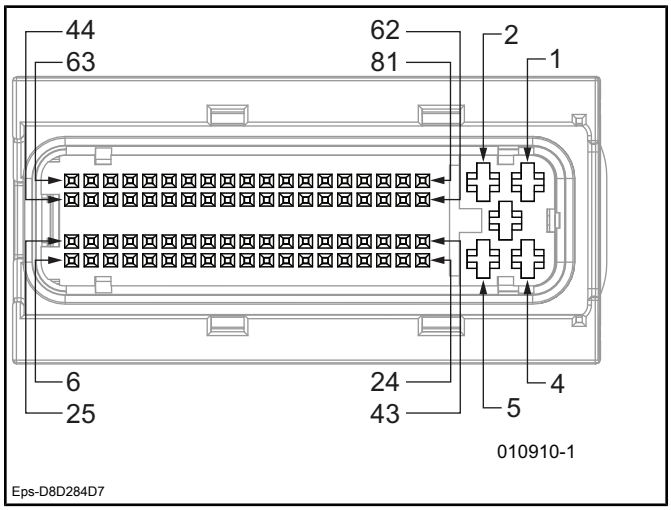
Engine Harness to Stator Connector



1. Stator connector

Pin No.	Description of Circuit	Wire Color
1	Stator winding (1S)	Yellow
2	Stator winding (3S)	Orange
3	Stator winding (2S)	Brown
4	Stator winding (1F)	Yellow/White
5	Stator winding (3F)	Brown
6	Stator winding (2F)	Brown/White

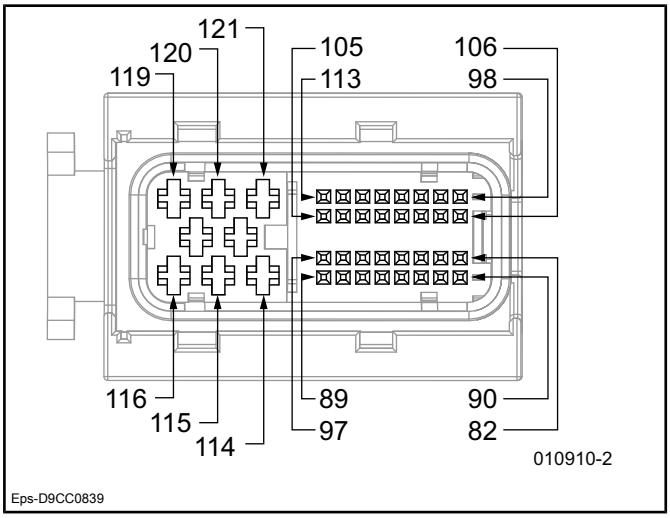
EMM J1 Connector



Pin No.	Description of Circuit	Wire Color
1	Stator Winding 2S	Orange
2	Stator Winding 2F	Brown/White Stripe
3	Empty	
4	Stator Winding 1S	Yellow
5	Stator Winding 1F	Yellow/White Stripe
6	Shift Actuator (+)	Yellow/Blue Stripe
7	Injector #3	Green
8	Throttle Motor (–)	Gray/White Stripe
9	Empty	
10	Analog Ground Out	Black/White
11	Analog Ground Out	Black/White
12	Throttle Motor (+)	Gray/Blue Stripe
13	Injector #2	Purple
14	Empty	
15	Exhaust Water Valve	Blue/Yellow Stripe
16	Coil #3	Orange/Green Stripe
17	Coil #2	Orange/Purple Stripe
18	Coil #1	Orange/Blue
19	Injector #1	Blue
20	Fuel Pump	Brown
21	Remote Oil Pump	Blue/Red Stripe
22	Shift Position 2 In	Yellow/Red Stripe
23	Water Pressure Sensor	Pink
24	Fuel Lift Pump	Brown/White Stripe
25	Shift Actuator (–)	Yellow/Green Stripe
26	Helm Power	Red/Purple Stripe
27	Empty	
28	Empty	
29	Analog Ground Out	Black/White
30	Analog Ground Out	Black/White
31	Analog Ground Out	Black/White
32	Trim Sender In	White/Tan Stripe
33	Water In Fuel Sensor	Pink/Green Stripe
34	Empty	
35	Empty	
36	Empty	
37	Fuel Level Lower	Brown/Green Stripe
38	Fuel Level Upper	Brown/Orange Stripe
39	DPS CAN Hi	Brown/Orange Stripe
40	DPS CAN Low	Orange/Black Stripe
41	Shift Position 1 In	Yellow/Black Stripe
42	Oil Level Sender	Pink
43	Vapor Solenoid	Brown/Yellow Stripe
44	Helm Ground	Black
45	Trim Up In	Blue/Black Stripe
46	Remote Control (Private) Can Hi	White
47	Remote Control (Private) Can Low	Blue
48	Empty	
49	Engine Temp Sensor	Pink/Black Stripe
50	Empty	
51	Empty	
52	Empty	
53	Empty	
54	Engine Stop	Black/Yellow Stripe
55	Empty	
56	Empty	
57	Empty	
58	Empty	
59	Knock (+)	Gray/Orange Stripe
60	Knock (–)	Gray/Black Stripe
61	*NMEA 2000* CAN S	Red
62	*NMEA 2000* CAN C Out	Black
63	Empty	
64	Trim Down In	Green/Black Stripe
65	Empty	
66	Tps In 1	Green/Yellow Stripe
67	Tps In 2	Green/Orange Stripe
68	Empty	
69	Empty	
70	Empty	
71	Air Temp Sensor	Pink/Blue Stripe

Pin No.	Description of Circuit	Wire Color
72	Empty	
73	Empty	
74	Empty	
75	Empty	
76	Empty	
77	Trim Up Out	Blue/White Stripe
78	Trim Down Out	Green/White Stripe
79	Fused B+ To 55v Enable	Purple/Yellow Stripe
80	*NMEA 2000* (Public) Can Low	Blue
81	*NMEA 2000* (Public) Can Hi	White

EMM J2 Connector



Pin No.	Description of Circuit	Wire Color
82	Bond Wire In	Green
83	Empty	
84	Rave Position	Green
85	CPS In	Yellow
86	Empty	
87	Pump Main Oil	Blue
88	Rave Actuator (–)	Purple/Yellow Stripe
89	Empty	
90	Empty	
91	Empty	
92	Empty	
93	CPS Ground	Yellow/White Stripe
94	Wake Up	Purple/Black Stripe
95	Empty	
96	Rave Actuator (**+**)	Yellow/Purple Stripe

Pin No.	Description of Circuit	Wire Color
97	Empty	
98	+5v Analog Out	Red/White Stripe
99	+5v Analog Out	Red/White Stripe
100	+5v Analog Out	Red/White Stripe
101	+5v Analog Out	Red/White Stripe
102	Empty	
103	Empty	
104	Empty	
105	*EMM* Power	Red/Purple Stripe
106	Starter Relay	Yellow/Red Stripe
107	Empty	
108	Empty	
109	Empty	
110	Empty	
111	Empty	
112	Empty	
113	Fused B**+** To 55	Purple/White Stripe
114	Power Ground	Black
115	Power Ground	Black
116	Power Ground	Black
117	System Gen (55v)	White/Red Stripe
118	System Gen (55v)	White/Red Stripe
119	B**+**	Red
120	B**+**	Red
121	B**+**	Red

Ground Circuits

ll ground circuits are essential to reliable outboard performance. Make sure all ground connections are clean and tight. Refer to wiring diagrams for specific wiring details.

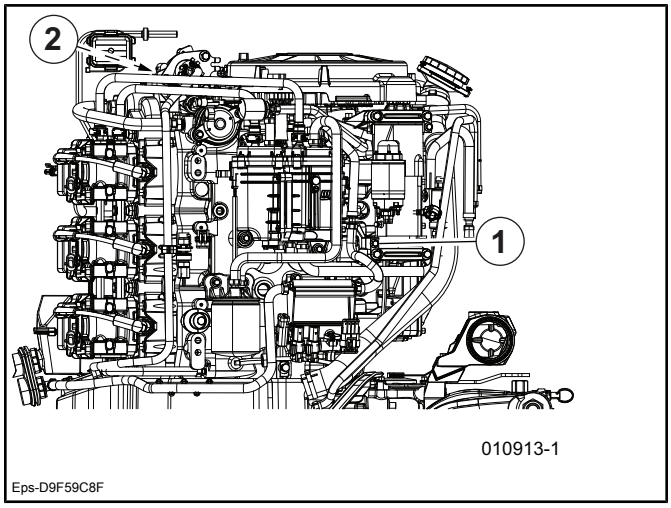
EMM Ground Test

Disconnect the battery cables at the battery.

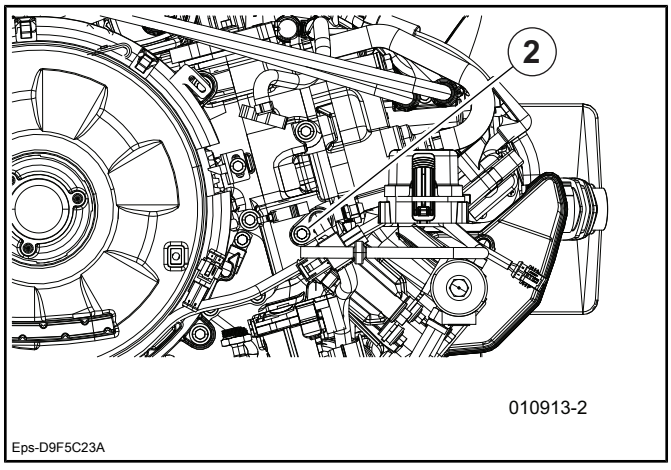
Additional Ground Tests

Check connections and continuity at the following locations:

– Main battery ground terminal
– Check continuity between ground terminals at port and starboard main harness grounds



1. Main engine harness ground (Starboard) Located on lower starter mounting brackcet
2. Main engine harness ground (Top)



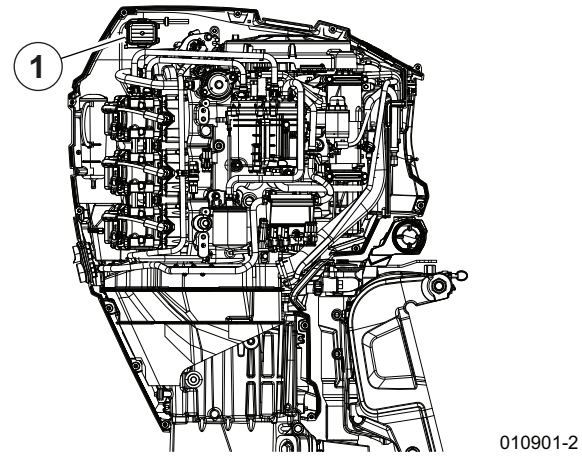
1. Main engine harness ground (Top Located under oil pump))

Use an ohmmeter to check continuity of ground circuits. Calibrate the ohmmeter on the high ohms scale. Resistance readings for all ground circuits should be 0 ohms. Refer to wiring diagrams.

Fuses

The engine harness circuits are protected by automotive style mini fuses and relays.

A fuse panel is mounted to a bracket on the port frame, near the top / rear of the powerhead. The fuse panel is accessible by removing the STARBOARD frame.



1. Fuse panel

IMPORTANT: Repeat failures of fuses could be the result of faulty connections or accessories. The 12 V accessory circuit (purple wire from terminal “A” of key switch) is often used to power accessories.

Electrical Testing

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Test probes such as P/N 342677, can be repaired, or can be made from a #3 safety pin.

The following parts are needed:

1. Socket, P/N 581656, or equivalent
2. Heat Shrink Sleeve, P/N 320597, or equivalent
3. 6 in. (152 mm) length of 18 AWG wire (obtain locally)
4. #3 Safety pins (obtain locally)

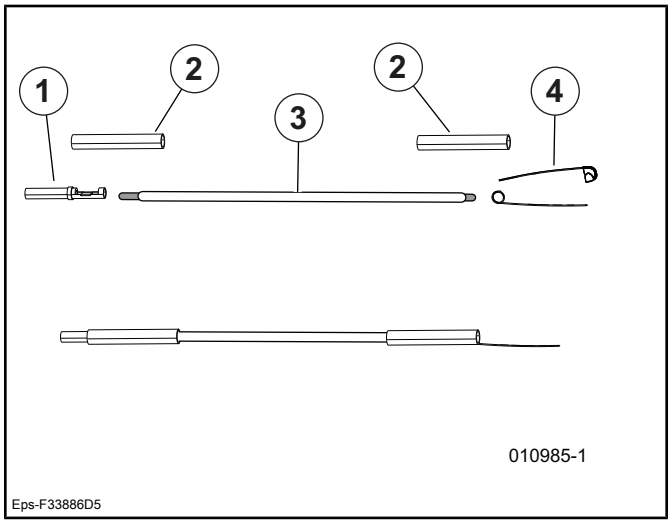
Cut the spring end from a #3 safety pin as shown.

For safety, dull the cut end and the sharp tip of the pin using a file or bench grinder.

Solder the one end of the wire lead through the spring of the pin. Apply a short length of heat shrink tubing to minimize accidental shorts. This can also serve as a grip for the pin end of the lead.

Crimp or solder the socket to the other end of the wire lead.

Apply a short length of heat shrink tubing to minimize accidental shorts.



1. Socket, P/N 581656
2. Heat shrink sleeve, P/N 320597
3. 18 AWG wire
4. #3 Safety pin

Sensor and Circuit Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Leads from the test probe kit can be repaired, or custom test leads can be made locally if needed. Refer to Electrical Testing, page 102.

All sensor circuits are dependent on wiring and connections, sensor resistance, and except for the CPS, *EMM* supplied current (5 V). The supplied current flows through the wiring circuit and sensor before returning to the *EMM*.

Circuit tests check the integrity of the main engine harness and *EMM* circuits using resistance or diode tests. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

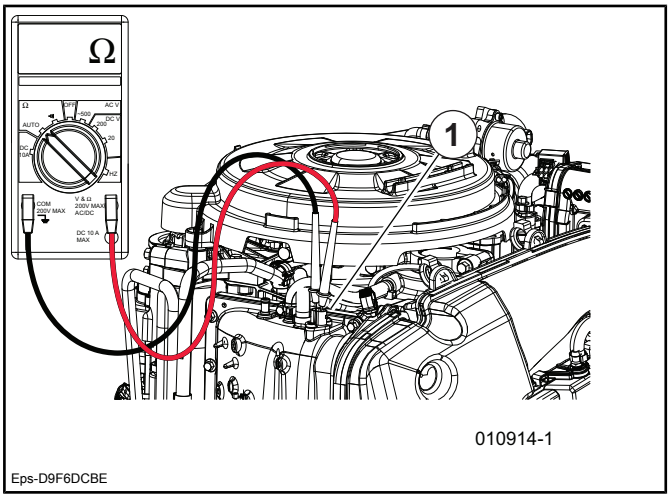
IMPORTANT: Use *Evinrude Diagnostics* software to monitor sensor circuit voltages or values.

Air Temperature Sensor

Air Temperature Sensor (AT) Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor resistance.



1. AT sensor

AT Sensor Resistance
680 Ω ± 5.25% @ 212°F (100°C)
10000 Ω ± 1.5% @ 77°F (25°C)
32654 Ω ± 3.0% @ 32°F (0°C)

Air Temperature Sensor (AT) Circuit Test

Remove the electrical connector from the air temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Air Temperature Sensor Circuit Resistance		
Wire	**Pin**	**Result**
PINK/BLUE	A	9700 Ω ± 200 Ω
BLACK/ WHITE	B	< 1 Ω

Results:

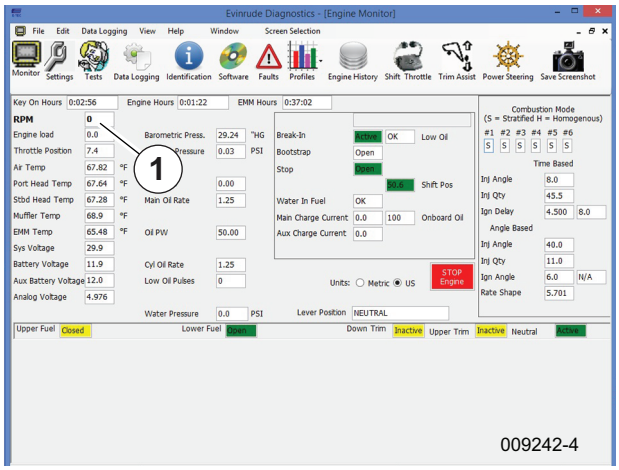
– An infinite (∞) reading indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Crankshaft Position Sensor

Crankshaft Position Sensor (CPS) Operation Test

Use the *Evinrude Diagnostics* software CPS Sync and engine RPM displays to confirm a valid CPS signal while the outboard is cranking or running. An RPM display higher than zero indicates a CPS signal to the *EMM*.

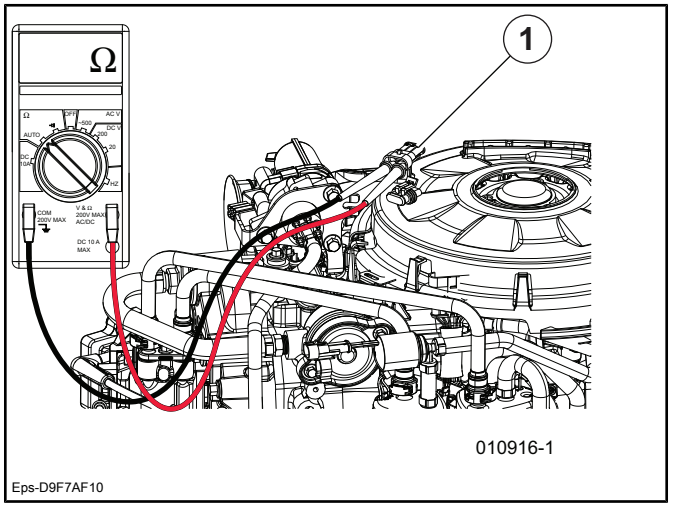


Engine Monitor Screen, Engine RPM Display

Crankshaft Position Sensor (CPS) Resistance Test

Disconnect the crankshaft position sensor. The CPS connector is clipped to the flywheel cover (see following picture).

Use a digital multimeter with appropriate test probe leads to measure sensor resistance between the yellow and white wires.



1. CPS sensor connector

Sensor Resistance
560 Ω ± 10% @ 77°F (25°C)

The CPS is mounted to the cylinder block and requires no adjustment. Air gap or clearance to flywheel is fixed at approximately 0.073 in. (1.85 mm). The acceptable clearance is 0.036 to 0.110 in. (1 to 2.8 mm).

Crankshaft Position Sensor (CPS) Circuit Test

Remove the electrical connector from the CPS.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the meter lead to the CPS engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

CPS Circuit Resistance		
Wire	**Pin**	**Result**
YELLOW	1	2000 Ω ± 3000 Ω
YELLOW/ WHITE	2	< 1 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

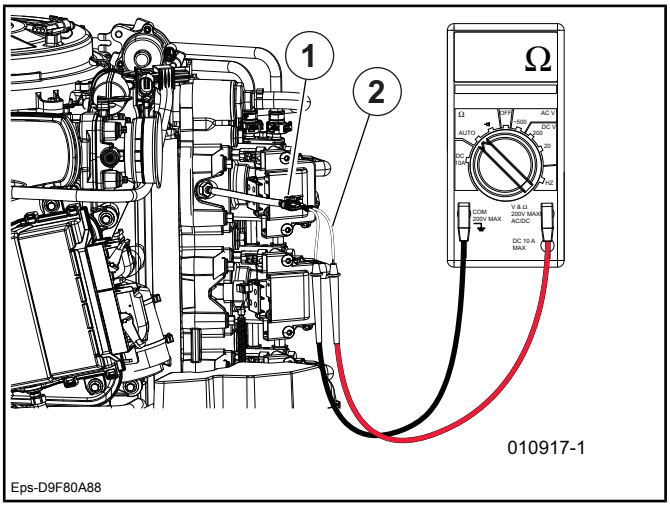
Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Engine Temperature Sensor

Engine Temperature Sensor Test

Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor resistance.



1. Engine temperature sensor

Engine Temperature Sensor Resistance
680 Ω ± 5% @ 212°F (100°C)
10000 Ω ± 1% @ 77°F (25°C)
32654 Ω ± 2.5% @ 32°F (0°C)

Engine Temperature Circuit Test

Remove the electrical connector from the engine temperature sensor.

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Engine Temperature Sensor Circuit Resistance		
Wire	**Pin**	**Result**
PINK/BLACK	2	430 Ω ± 200 Ω
BLACK/ WHITE	1	< 1 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Knock Sensor

Knock Sensor Test

There are no tests for the knock sensor. If *Evinrude Diagnostics* reports Fault Code 7 or 8, replace with a new sensor.

Make sure sensor retaining screw is tightened to a torque of 14 to 16 ft. lbs. (19 to 22 N·m).

Knock Sensor Circuit Test

There are no tests for the knock sensor signal wires. Use a digital multimeter with appropriate test probe leads to measure sensor ground circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Knock Sensor Ground Circuit Resistance		
Wire	**Pin**	**Result**
GRAY/BLACK	A	< 1 Ω

Ignition System

SERVICE TOOLS

Description	Part Number	Page
CONNECTOR SERVICE TOOL	P/N 342667	126
CRIMP TOOL WITH DIES	P/N 777281	128
CRIMPING PLIERS	P/N 322696	127
ELECTRICAL TEST PROBE KIT	P/N 342677	114
FLYWHEEL HOLDING TOOL	P/N 359868	121
FLYWHEEL NUT SOCKET	P/N 357715	121–122
FLYWHEEL PULLER	P/N 357714	120
FLYWHEEL SOCKET	P/N 357715	120
PISTON STOP TOOL	P/N 342679	122
PRIMARY LOCK TOOL	P/N 777077	127
SECONDARY LOCK INSTALLER	P/N 777079	128
SECONDARY LOCK TOOL	P/N 777078	127
TIMING LEAD	P/N 587316	124

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	P/N 503243	126
GASKET SEALING COMPOUND	P/N 508235	121
MOLY LUBE	P/N 768306	120
NO-OX GREASE	P/N 768230	125
NUT LOCK	P/N 500418	121–122, 125

⚠ DANGER

The electrical system presents a serious shock hazard. Allow the outboard to sit for two minutes after running, BEFORE handling the capacitor or 55 V electrical components. Failure to handle capacitor properly can result in uncontrolled electrical discharge and possible electrical shock to humans. DO NOT handle primary or secondary ignition components while outboard is running or flywheel is turning.

Use the *Evinrude Diagnostics* software to check for fault codes before troubleshooting. Correct any problems and clear the codes FIRST.

Required Systems

Following is a complete list of circuits required for ignition output.

Stop Circuit

– Black/yellow wire NOT grounded (emergency stop switch lanyard in place)

Battery

– Battery switched B+ input to power up *EMM*
– Battery B+ input to Start Assist Circuit (SAC) of *EMM*

Stator Output Voltage

– Provides A/C voltage to *EMM* J1 connector, pins 1, 2, 4, and 5:
– Outboard cranking, typical range is 20-40 VAC (AC output voltage is related to cranking RPM); Outboard running approximately 55 VAC.

EMM

- Controls ignition activation, injector activation and ignition timing
- Start Assist Circuit (SAC) converts battery voltage (12 V) to 30 V (approximately) for system circuit (55 V)

Crankshaft Position Sensor

- Provides *EMM* with input
- Outboard cranking speed exceeds 75 RPM and a steady CPS signal is generated

Alternator Output/System Voltage

- System voltage from *EMM* (white/red) provides 55 VDC to the oil pump, fuel injectors, and the ignition circuits of *EMM*

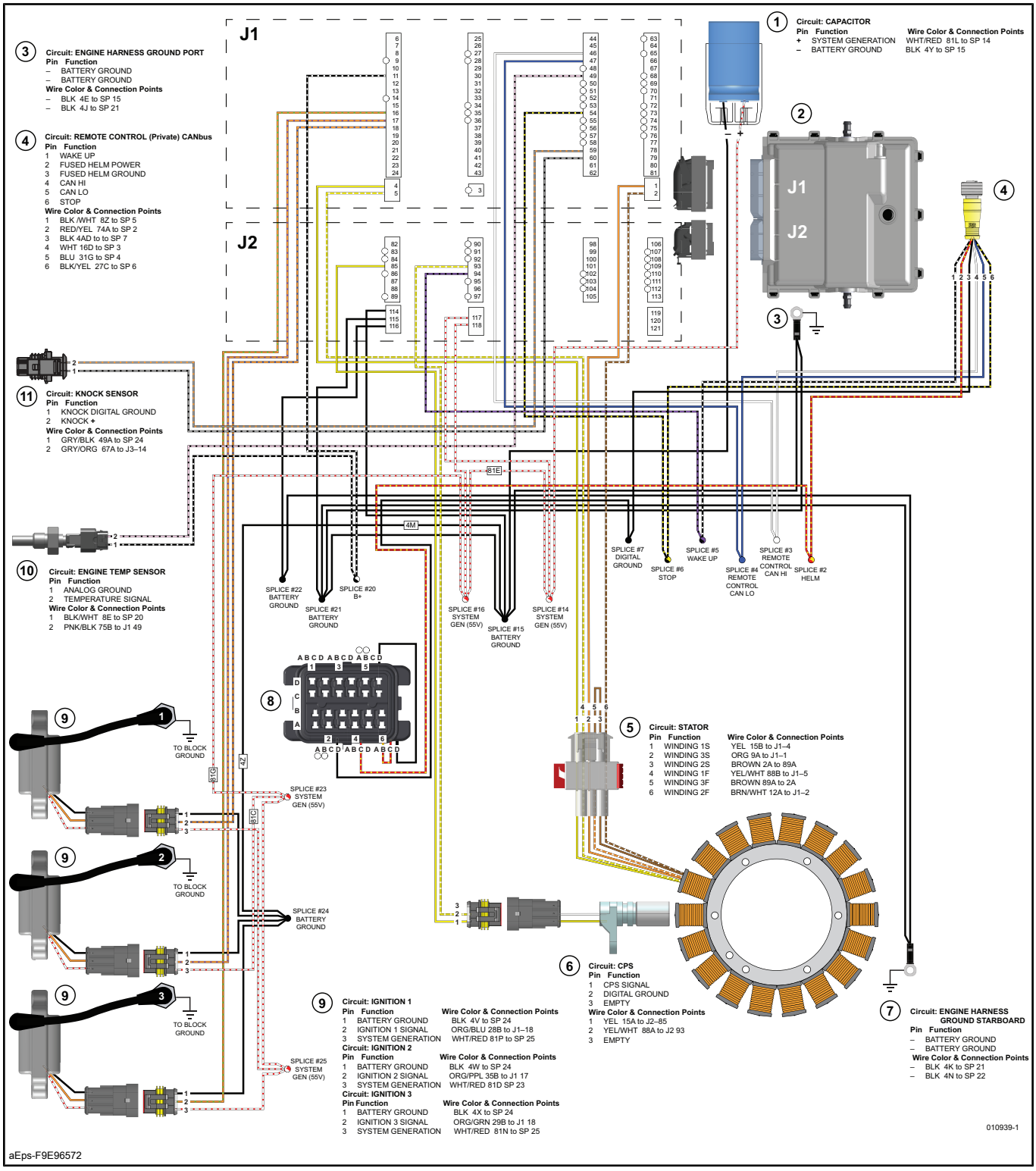
Capacitor

- Connected to 55 V circuit (white/red) to stabilize current on 55 V circuit
- Negative terminal of capacitor must be grounded

Ignition Coil

- Primary circuits are powered by system (55 V) voltage
- *EMM* provides control signal to ignition coil
- Output from ignition coil secondary winding and high tension spark plug wire

Ignition System Circuit Diagram



Legend	
B +	Battery Positive
B –	Battery Negative (ground)
BLK	Black
BLU	Blue
BRN	Brown
CAN	Controller Area Network
GND	Ground
GRN	Green
GRY	Gray
J1	EMM J1 Connector
J2	EMM J2 Connector
ORG	Orange
PNK	Pink
PPL	Purple
RED	Red
SP	Splice
TAN	Tan
WHT	White
YEL	Yellow

Component List	
1	Capacitor
2	*EMM*
3	Engine Harness Ground (Port)
4	Remote Control (Private) CANbus
5	Stator
6	Crankshaft Position Sensor (CPS)
7	Engine Harness Ground (Starboard)
8	Fuse Panel
9	Ignition Coilsr
10	Engine Temperature Sensor
11	Knock Sensor

Fuse Panel Pinouts

Pin	Function	Wire Color and Connection Points	Pin	Function	Wire Color and Connection Points
1A	Fused B+	RED/PPL 41G to SP 17	4A	Relay KL87 (Output)	RED/TAN 80B to Start Solenoid
1B	Fused B+	RED/PPL 41H to SP 17	4B	Relay KL86 (Control +)	RED/PPL 41E to SP 12
1C	B+	RED 13Q to SP 18	4C	Fused Helm Power	RED/YEL 74B to SP 2
1D	Battery Ground (–)	BLK 4F to J1–44	4D	Fused B+	RED/PPL 41B to SP 12
2A	Empty	–	5A	Empty	–
2B	Empty	–	5B	Empty	–
2C	Fused B+	RED/PPL 41F to SP 17	5C	B+ (Start Solenoid)	RED 13P to SP 18
2D	Battery Ground (–)	BLK 4DD to SP 7	5D	Spare	BLK 4CA to Fuse Block 6D
3A	Switched B+ to 55V Relay In	PPL/YEL 20D to J1–79	6A	Relay KL85 (Control –)	YEL/RED 25A to J2–106
3B	Switched B+ to 55V Relay Out	PPL/WHT 21A to SP 19	6B	Relay KL 30 (Supply to)	RED/YEL 74C to Fuse Block 6C
3C	Fused B+	RED/PPL 41M to J1–26	6C	Fused Helm Power	RED/YEL 74C to Fuse Block 6B
3D	B+ *EMM*	RED 13R to SP 18	6D	Spare	BLK 4CA to Fuse Block 5D

Wiring Inspection

Visually inspect all wiring, connection and grounds.

Use a digital ohmmeter to test resistance on all ground circuits and connections. Ohmmeter readings should be approximately 0.0 Ω.

Check that all engine wire harness grounds have continuity to the cylinder/crankcase. See **Ground Circuits**.

Clean or repair all ground circuits, wiring, and connections as needed.

Ignition System Tests

NOTICE

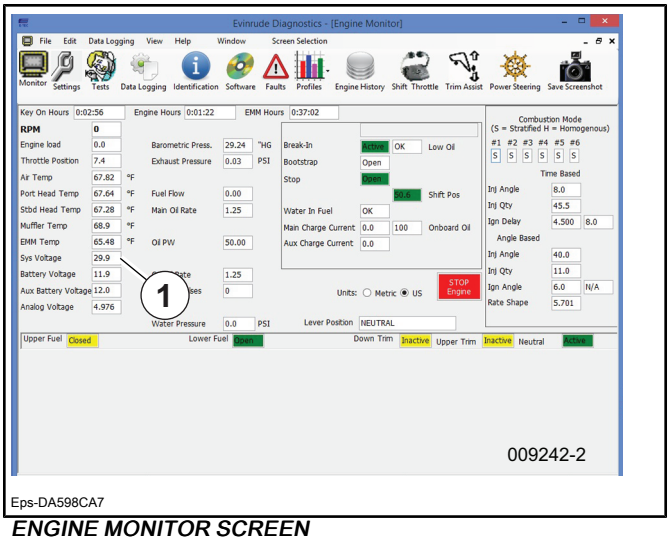
Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Before continuing make sure the CPS is operating. Refer to **Crankshaft Position Sensor (CPS) Operation Test**. If the Monitor screen says "Check CPS Sync," refer to **Crankshaft Position Sensor (CPS) Resistance Test**.

System Voltage Test

The ignition system is powered by the 55 V system.

Use the *Evinrude Diagnostics* software *Monitor* screen to check system voltage.



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ENGINE MONITOR SCREEN

1. System Voltage Display

Results:

- *EMM* ON (not running): 30 V ± 2, system voltage is GOOD
- *EMM* ON (not running): less than 30 V ± 2, check 12 V power to *EMM*. Repair connection or wiring. Possible fault in *EMM* SAC circuit
- RUNNING: 55 V ± 2, system voltage is GOOD
- RUNNING: less than 55 V ± 2, check stator output to *EMM*. Repair connection or wiring. Possible faulty stator or *EMM*. Refer to **Stator Tests**.

IMPORTANT: The *EMM* must be ON for voltage to be present on the system voltage (55 V) circuit. Power is normally supplied to the *EMM* when the key switch is turned ON. The *EMM* is also turned ON when it begins to receive AC voltage from the stator while the outboard is being cranked.

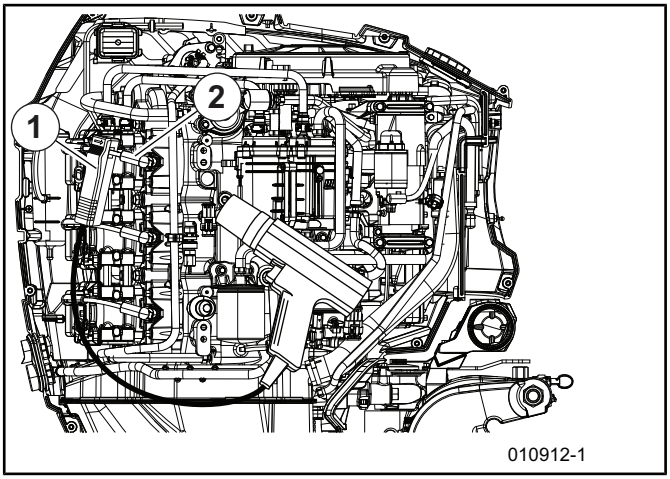
Running Ignition Tests

Use *Evinrude Diagnostics* software to monitor system voltage (55 V).

- Voltage readings at a specific speed (RPM) should be steady.
- Refer to **System Voltage Test**.

Use an inductive timing light to monitor the spark signal through each of the secondary circuit (spark plug lead) wires.

Start outboard and observe timing light strobe. Look for a consistent flash and only one flash per revolution. The strobe of the timing light should be the same for each cylinder.



1. Timing light pick-up
2. Spark plug lead

Results:

Steady voltage and strobe, engine misfires:

- Inspect or replace spark plugs
- Refer to **Static Test**
- Check for internal engine damage

Steady voltage, erratic strobe, engine misfires:

- Inspect or replace spark plugs
- Check CPS resistance
- Refer to **Ignition Circuit Tests**
- Refer to **Ignition Coil Tests**

Voltages fluctuate, engine misfires:

– Inspect battery and connections
– Test capacitor and all ground connections
– Refer to **System Voltage Test**
– Refer to **Ignition Circuit Tests**
– Refer to **Ignition Coil Tests**

IMPORTANT: If a running problem occurs at about 1200 RPM, the outboard may be in *S.A.F.E.* Refer to ***S.A.F.E.***.

Ignition Coil Tests

There are no ignition coil tests available. Before replacing an ignition coil, be sure:

– 55 V is supplied to the white/red wire of the ignition coil connector
– A control signal is present on the orange wire of the ignition coil connector. Refer to **Ignition Circuit Tests**.
– The black wire of the ignition coil connector provides continuity to ground.
– The secondary spark plug lead provides continuity.

If all of the above tests are good, and a cylinder does not have spark, replace the ignition coil with a known good coil.

Ignition Circuit Tests

Ignition 55V Circuit Voltage Test

Use a digital multimeter calibrated to a scale that reads 55 V (DC) to measure voltage between the ignition coil electrical connector and engine ground.

Disconnect ignition coil connector.

Connect negative meter lead to ground. Use an appropriate test probe lead to connect positive meter lead to pin 3 (white/red wire) of engine harness electrical connector.

Turn the key switch to the ON position. Observe voltage at pin 3.

– Voltage should be approximately 30 V.

Start the engine. Observe voltage at pin 3.

– The voltage at pin 3 should be approximately 55 V.

NOTE: This will result in an Ignition Coil OPEN Circuit fault code.

Results:

– No voltage reading, confirm 55V Circuit Resistance. Refer to **Ignition 55V Circuit Resistance Test**
– No voltage reading, refer to **System Voltage Test**

Ignition 55V Circuit Resistance Test

Disconnect the electrical connector from the ignition coil.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the 55V circuit.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table.

Connect the negative meter lead to the red/white wire of a known good circuit such as a fuel injector.

Ignition 55V Circuit Test		
Wire	Pin	Result
WHITE/RED	3	< 1 Ω

Results:

An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Ignition Ground Circuit Resistance Test

Use a digital multimeter with appropriate test probe leads to measure the ground circuit resistance.

Make sure the key switch is in the OFF position. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Ignition Ground Circuit Resistance		
Wire	**Pin**	**Result**
BLACK	1	< 1 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Ignition Control Circuit Voltage Test

Disconnect the electrical connector from the ignition coil.

Use a digital multimeter with appropriate test probe leads to measure signal circuit voltage.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground. Turn the key switch to the ON position.

Ignition Circuit Voltage		
Wire	**Pin**	**Result**
ORANGE/BLUE (upper cylinder)	2	5–7 VDC
ORANGE/PURPLE (middle cylinder)	2	
ORANGE/GREEN (lower cylinder)	2	

Capacitor Test

IMPORTANT: Make sure the capacitor is discharged before testing.

Disconnect the capacitor from electrical harness. Use an ohmmeter set on the high ohms scale to test the capacitor. Connect the meter leads to the capacitor terminals:

- If the capacitor is working correctly, it will store energy from the meter. The resistance reading will increase until it goes to (nearly) infinity.
- If the capacitor is shorted, the reading will immediately show full continuity.
- If there is an open circuit in the capacitor, the meter will show no continuity.

If the resistance reading starts as a negative number, or the reading goes down in value, the capacitor already retains some stored energy. Ground the capacitor and test again.

Stator Tests

NOTICE

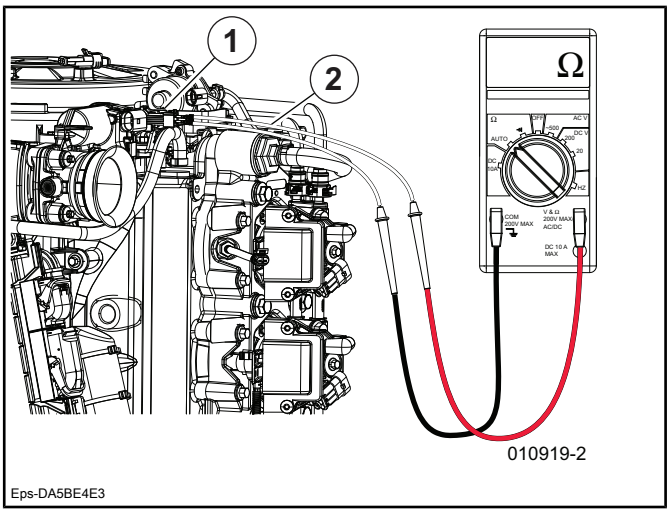
Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

The stator consists of 3 windings (6 poles each) on a 7 inch diameter core and generates an output voltage of 55 VAC (1700 watts maximum). This voltage is converted by the *EMM* and provides 55 VDC for fuel injector, fuel and oil pump operation. The ignition module of *EMM* is also powered by the 55 VDC output.

Stator Resistance Tests

Use a digital multimeter with appropriate test probe leads to check resistance of stator windings.

Disconnect the stator (6-pin) connector from the engine harness (6-pin) connector.



1. *Stator 6–pin connector*
2. *Adapter leads*

Use an appropriate adapter to connect the meter leads to the following pins of the stator connector:

Stator Winding Resistance		
Wire	**Pin**	**Result**
YELLOW	1	0.512 ± 0.020 Ω @ 73°F (23°C)
YELLOW/WHITE	4	
ORANGE	2	0.512 ± 0.020 Ω @ 73°F (23°C)
ORANGE/WHITE	5	
BROWN	3	0.512 ± 0.020 Ω @ 73°F (23°C)
BROWN/WHITE	6	

IMPORTANT: A reading of less than 2 ohms is acceptable. Make sure meter is calibrated to read 1 ohm or less.

Check for a grounded winding. Connect one meter lead to ground and alternately connect the other meter lead to each stator wire. Meter should read no continuity. If meter reads continuity, replace stator.

Stator Voltage Output Test

⚠ WARNING

To prevent accidental starting of outboard, disconnect the crankshaft position sensor (CPS).

Use a voltmeter to check the stator output voltage. Set meter to read 110 VAC output. Disconnect the CPS.

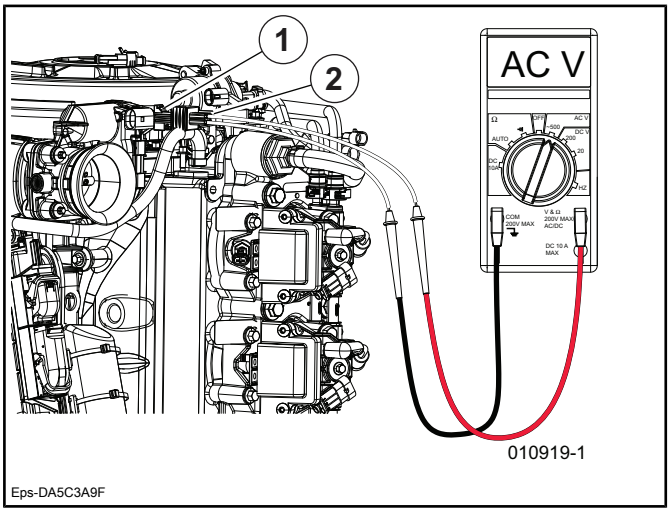
Disconnect the stator (6-pin) connector from the engine harness (6-pin) connector.

Connect Stator Test Adapter tool, P/N 5006211, to the stator connector.

Connect meter leads to terminals of adapter tool.

With a fully charged battery, crank the outboard (100 RPM minimum) and observe meter reading:

– 20 VAC at 100 RPM
– 30 VAC at 150 RPM
– 42 VAC at 200 RPM
– 52 VAC at 250 RPM
– 62 VAC at 300 RPM



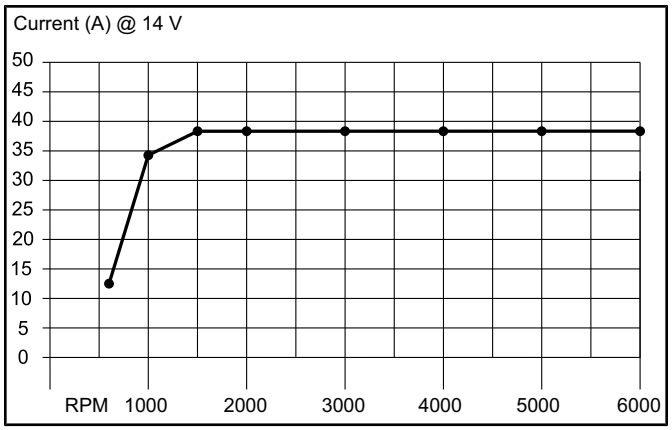
1. Stator 6–pin connector
2. Stator Test Adapter, P/N 5006211

Charging System Tests

The charging system provides 12 VDC for battery charging. Alternator total output, or *GROSS* output is:

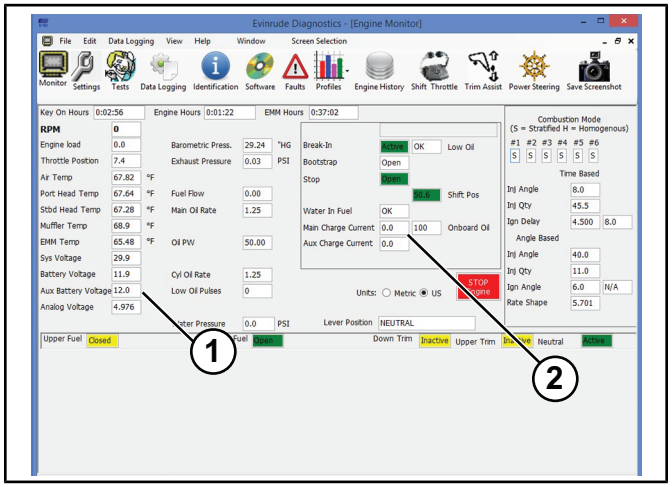
– 10 A at 500 RPM
– 50 A from 2000 RPM to WOT

Charging system available output to the battery, or NET output is shown in the following graph:



BATTERY CHARGING CURRENT (NET) @ 14 VDC

Use *Evinrude Diagnostics* software to monitor battery voltage and *GROSS* charge current.

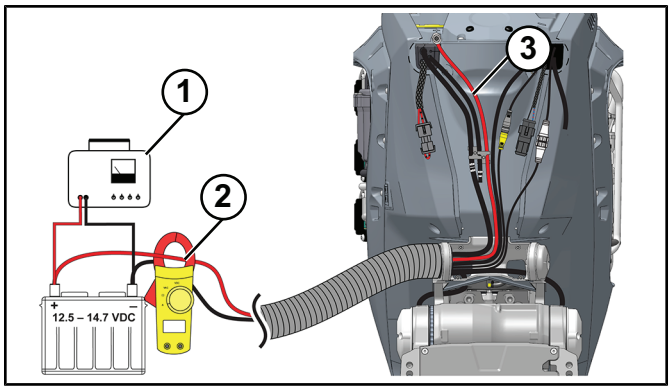


ENGINE MONITOR SCREEN

1. Main and auxiliary battery voltage display
2. Main and auxiliary charge current display

Use an inductive amp meter to monitor *NET* charge current at the battery. *Fluke*, *Snap-On* or various other digital meters should be available through local tool suppliers.

Connect an inductive amp meter to the positive (B +) battery cable at the battery.



VARIABLE LOAD TEST DIAGRAM

1. *Variable load tester*
2. *Inductive ammeter (optional)*
3. *Battery cable (B+)*

12 V Charging Circuit

⚠ WARNING

Excessive battery discharge rates might overheat battery causing electrolyte gassing. This might create an explosive atmosphere. Always work in a well ventilated area.

To test the operation of the regulator in the EMM, and amperage output of the charging system you must be able to run the outboard continuously at approximately 2000 RPM, such as in a test tank or on a marine dynamometer.

Monitor the charging system's response to a partially discharged battery. Use a variable load tester (carbon pile) to discharge the battery.

IMPORTANT: The regulator requires voltage to operate. Before proceeding, make sure there is at least 7 V on the positive terminal of the starter solenoid.

NOTE: This outboard has dual output charging. Each output is isolated and regulated. Each output is approximately 20 A (NET). Combined output is approximately 40 A (NET).

Following the manufacturer's directions, connect the variable load tester across the battery terminals.

Start and run the outboard at approximately 2000 RPM. Use the variable load tester to draw the battery down at a rate equivalent to the stator's full output.

– The ammeter should indicate nearly full output, approximately 30 A.

Decrease the battery load toward 0 A.

– Ammeter should show a reduced output. As the current draw decreases, the battery voltage should stabilize at approximately 14.5 V.
– If results vary, check stator BEFORE replacing the *EMM*. See **Stator Tests**.

55 V Alternator Circuit

1. Check battery ground cable for continuity.
2. With the key switch ON, check battery voltage at battery (12 V).

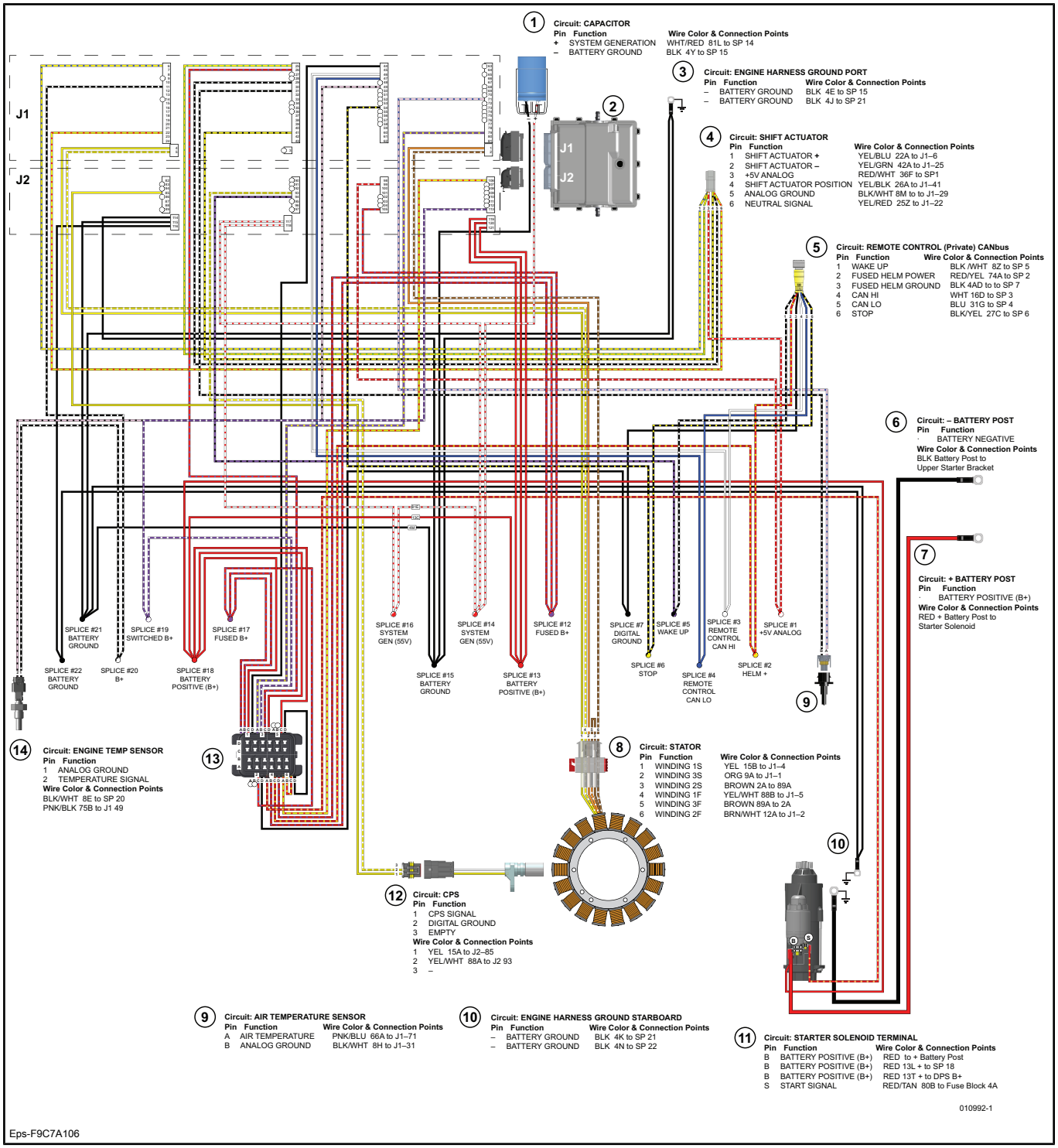
Required Tool
Electrical Test Probe Kit **P/N 342677**

3. Then, use Electrical Test Probe Kit, P/N 342677, and a digital multimeter set to read 55 VDC to check voltage on white/red wires at an ignition coil or fuel injector electrical connector.

Acceptable Alternator Circuit Test Readings	
Key switch ON	approximately 30 VDC
Engine running	approximately 55 VDC

4. With outboard running at 1000 RPM, voltage on white/red wires should increase to 55 V. Voltage readings at a specific speed (RPM) should be steady.
5. If there is any other reading, refer to **Stator Tests**. Inspect the stator wiring and connections. Inspect the capacitor wiring, connections, and capacitor. Repair the wiring or replace a faulty capacitor, stator, or *EMM*.

Electric Start Circuit Diagram



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Legend	
B +	Battery Positive
B –	Battery Negative (ground)
BLK	Black
BLU	Blue
BRN	Brown
CAN	Controller Area Network
GND	Ground
GRN	Green
GRY	Gray
J1	EMM J1 Connector
J2	EMM J2 Connector
ORG	Orange
PNK	Pink
PPL	Purple
RED	Red
SP	Splice
TAN	Tan
WHT	White
YEL	Yellow

Component List	
1	Capacitor
2	*EMM*
3	Engine Harness Ground (Port)
4	Shift Actuator
5	Remote Control (Private) CANbus
6	Battery Negative Post (–)
7	Battery Positive Post (**+**)
8	Stator
9	Air Temperature Sensor
10	Engine Harness Ground (Starboard)
11	Starter Solenoid Terminals
12	Crankshaft Position Sensor (CPS)
13	Fuse Panel
14	Engine Temperature Sensor

Fuse Panel Pinouts

Pin	Function	Wire Color and Connection Points	Pin	Function	Wire Color and Connection Points
1A	Fused B+	RED/PPL 41G to SP 17	4A	Relay KL87 (Output)	RED/TAN 80B to Start Solenoid
1B	Fused B+	RED/PPL 41H to SP 17	4B	Relay KL86 (Control +)	RED/PPL 41E to SP 12
1C	B+	RED 13Q to SP 18	4C	Fused Helm Power	RED/YEL 74B to SP 2
1D	Battery Ground (–)	BLK 4F to J1–44	4D	Fused B+	RED/PPL 41B to SP 12
2A	Empty	–	5A	Empty	–
2B	Empty	–	5B	Empty	–
2C	Fused B+	RED/PPL 41F to SP 17	5C	B+ (Start Solenoid)	RED 13P to SP 18
2D	Battery Ground (–)	BLK 4DD to SP 7	5D	Spare	BLK 4CA to Fuse Block 6D
3A	Switched B+ to 55V Relay In	PPL/YEL 20D to J1–79	6A	Relay KL85 (Control –)	YEL/RED 25A to J2–106
3B	Switched B+ to 55V Relay Out	PPL/WHT 21A to SP 19	6B	Relay KL 30 (Supply to)	RED/YEL 74C to Fuse Block 6C
3C	Fused B+	RED/PPL 41M to J1–26	6C	Fused Helm Power	RED/YEL 74C to Fuse Block 6B
3D	B+ *EMM*	RED 13R to SP 18	6D	Spare	BLK 4CA to Fuse Block 5D

Electric Start Circuit Description

Wiring

The positive (B +) battery cable connects to the positive terminal stud in the engine rigging center.

The positive terminal stud:

– Connects a cable to the large terminal of the starter solenoid
– Provides 12 V to the engine harness (red wire) and the fuse panel terminals 1C, 3D and 5C

The negative (B-) battery cable connects to the negative terminal stud in the engine rigging center. A cable connects this terminal to a ground terminal on the starter. The main harness ground is provided through the starter mounting screws.

Engine Wire Harness

Contains the following circuits:

Red/purple wires:

– Fuse Panel terminal 3C, provides fused 12 V to the START RELAY coil (terminal 8B) and to the EMM J1-B connector terminal 26
– EMM J2 connector terminal 105, provides 12 V via SPLICE 12, to Fuse Panel 4B and 4D, and to the trim switch. This circuit is always "ON".

Red/yellow wires:

– Fuse Panel terminal 2C , provides 12 V to the remote control
– Fuse Panel terminal 6B, provides high current 12 V to the START RELAY

Yellow/red wires:

– *EMM* J1 connector terminal 22, Provides NEUTRAL signal from the shift actuator to the *EMM*
– *EMM* J2 connector terminal 108, Provides the start signal from the *EMM* to the start relay

Red/tan wires:

– Provides the start signal voltage from the start relay fuse panel terminal 4A to the starter solenoid.

Remote Control CANbus Harness

Contains the following circuits:

Red/yellow wire:

– Provides 12 V from the HELM fuse (terminal 4C) to the remote control

Black wire:

– Provides HELM ground

Black/yellow wire:

– Engine STOP circuit

Blue and white wires:

– Provides CANbus data signal (low and high) to/from the *EMM*

Black/white wires:

– Turns ON the *EMM*

Key Switch ON Position

When the key switch is turned to the ON position the remote control black/white wire provides 12 V to the purple/black wire (*EMM* J2 connector terminal 94) and turns ON the *EMM*.

Start Command

1. Key Switch Start: Grounds terminal S of the key switch, which signals remote control to transmit the START signal to the engine *EMM*.

2. Push Button Start Switches: Sends a digital signal to the remote control to transmit the START signal to the engine *EMM*.

Then:

– If the remote control is in the NEUTRAL position, the START command is transmitted over the remote control and *NMEA 2000* networks to the *EMM*.
– The *EMM* checks for NEUTRAL signal from the shift actuator. If the *EMM* detects the NEUTRAL signal, it grounds the yellow/red wire (*EMM* J2 connector, terminal 106). This energizes the START RELAY, providing 12 V to the starter solenoid.

Electric Starter Tests

⚠ WARNING

To prevent accidental starting of outboard, disconnect the crankshaft position sensor (CPS).

Confirm the following BEFORE beginning any tests on the starting system:

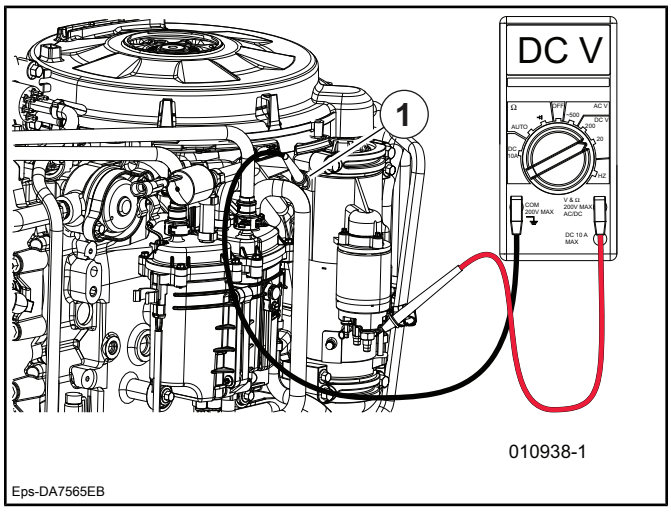
- Battery voltage at the battery is a minimum of 12 V.
- Turn key switch to the ON position, does the fuel pump run?
  - Yes, the remote control and *EMM* are ON.
  - No, the *EMM* is OFF. Check remote control network and connections. Check tether cord is attached to emergency stop switch (second station in dual station application).
- Check the remote control gear position. The remote control MUST be in NEUTRAL, the engine will NOT crank if in gear.

Starter Voltage Test

Use a digital multimeter to check battery voltage at the battery. Crank the engine and record the voltage.

Use a digital multimeter to check voltages at the starter.

Connect the positive meter lead to the battery (B) terminal on the starter. Connect the negative meter lead to the ground terminal on the starter housing.



1. Starter housing ground terminal

Results:

- Recorded battery voltage ± 0.5 V: Readings are GOOD.
- Less than recorded battery voltage: Check positive and negative cable connections at the starter, center frame and at the battery.

Connect the positive meter lead to the start (S) terminal on the starter. Connect the negative meter lead to the ground terminal on the starter housing. Crank the engine.

Results:

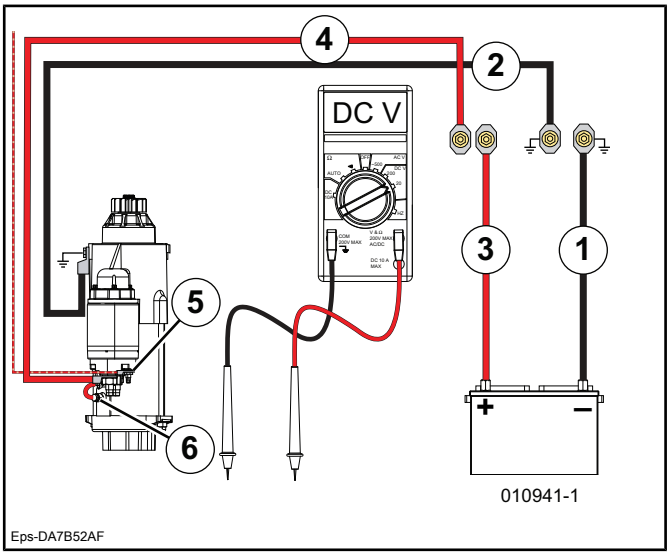
- Recorded battery voltage ± 0.5 V: Readings are GOOD.
- Less than recorded battery voltage: Check 30 A fuse and start relay.

Starter Voltage Drop Test

Use a digital voltmeter to measure the voltage drop on each section of the start circuit.

STEP 1: Connect voltmeter positive (+) lead to the terminal for the negative (–) battery cable at the starter. Connect voltmeter negative (–) lead to negative (–) battery post.

- Activate the starter motor and record the voltage reading.



1. Negative battery cable (battery to rigging center)
2. Negative battery cable (rigging center to starter housing)
3. Positive battery cable (battery to rigging center)
4. Positive battery cable (rigging center to solenoid “B” terminal)
5. Solenoid “S” terminal
6. Starter cable

STEP 2: Connect positive (+) lead to battery positive (+) terminal. Connect negative (–) lead to starter solenoid “B” terminal.

- Activate the starter motor and record the voltage reading.

STEP 3: Connect positive (+) lead to starter solenoid terminal. Connect negative (–) lead to opposite starter solenoid terminal.

– Activate the starter motor and record the voltage reading.

STEP 4: Connect positive (+) lead to starter cable of solenoid terminal. Connect negative (–) lead to starter motor terminal.

– Activate the starter motor and record the voltage reading.

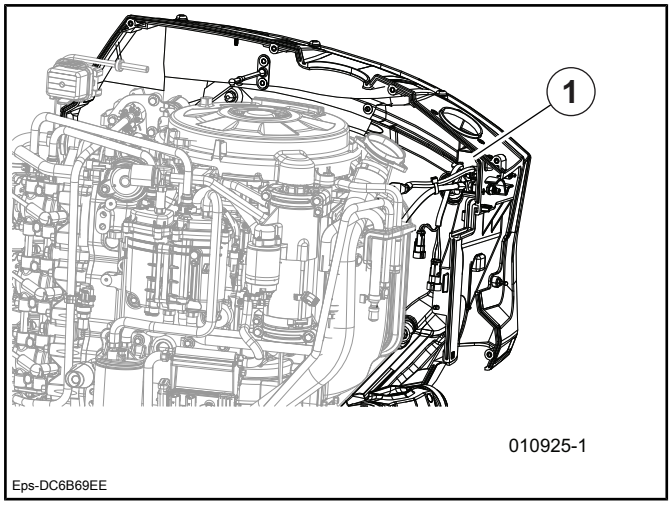
Results:

If the voltage reading from any step is greater than 0.5 VDC check that connections are clean, tight and free of corrosion. Clean or replace any corroded or damaged cables or connections.

Trim/Tilt Relay Test

The tilt and trim (TNT) module contains the circuitry and relays required for power trim and tilt operation.

The TNT module is stored in a pocket in the PORT frame.



1. Tilt and trim module

The tilt and trim switch provides B+ input to green/white or blue/white wire of the TNT module.

Operation

The relay activates when B+ input from the switch is supplied to terminal 86 of the internal relays.

Terminal 87a connects to ground (B–).

Terminal 87 connects to B+.

Terminal 30 connects TNT motor.

Terminals 87a and 30 are connected when relay is not activated. This supplies ground (B–) connection to TNT motor.

Terminals 87 and 30 are normally open. B+ is applied to terminal 30 when relay is activated. This supplies B+ connection to TNT motor.

Refer to the **Trim and Tilt Module Diagram**.

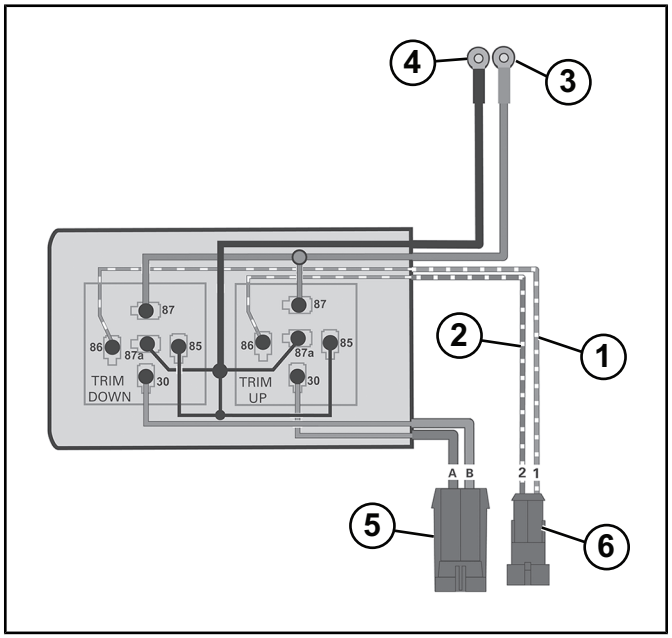
Test Procedure

Make sure red and black wires are connected to 12 V battery power supply.

Set voltmeter to 12 VDC scale. Connect test leads to terminals “A” and “B” of TNT motor connector.

Use a wire jumper to alternately connect B+ to terminals “1” and “2” of tilt and trim switch connector.

The meter must indicate battery voltage (12 V) with B+ connected to either terminal.



TRIM AND TILT MODULE DIAGRAM

1. *Green/white wire*
2. *Blue/white wire*
3. *B+ red wire*
4. *B- black wire*
5. *TNT motor connector*
6. *TNT switch connector*

Flywheel and Stator Servicing

NOTICE

Perform the timing verification procedure after flywheel replacement.

IMPORTANT: Weak flywheel magnets can cause low alternator output and affect outboard performance.

An accurate test of alternator output can help determine the flywheel’s condition. Refer to **Charging System Tests**.

Flywheel Removal

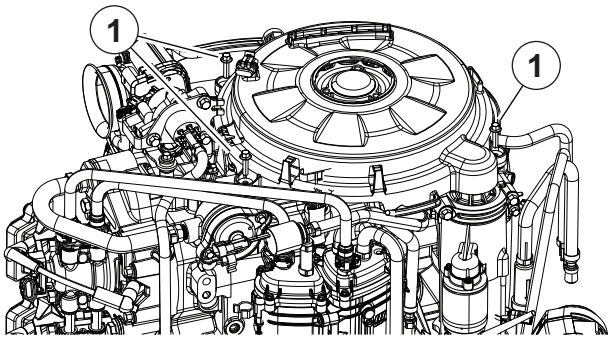
⚠ WARNING

To prevent accidental starting while servicing, disconnect the battery cables at the battery.

Removal and installation requires removal of the engine covers and frames.

Refer to **Engine Cover and Frame Service**.

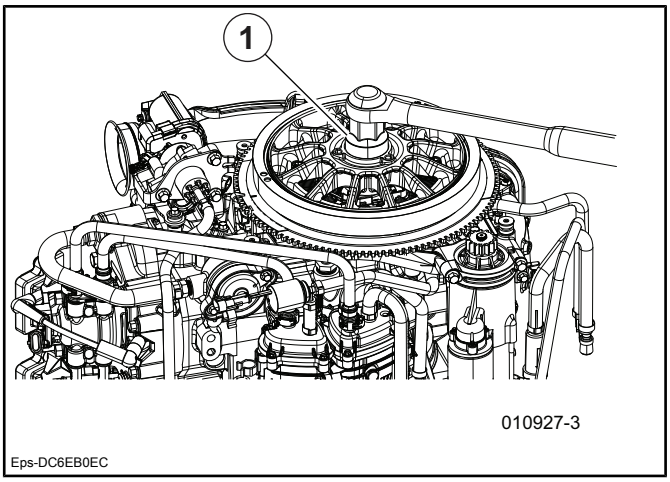
1. Use a #2 *Posi-Drive* screwdriver to remove the screws from the flywheel cover. Then remove the cover.



1. Screws

Required Tools
Flywheel Socket
P/N 357715
Flywheel Puller
P/N 357714

2. Use Flywheel Socket, P/N 357715, to remove flywheel nut. Discard the flywheel nut.



1. Flywheel Socket, P/N 357715

Required Chemical
Moly Lube
P/N 768306

3. Use Flywheel Puller, P/N 357714, to remove the flywheel. Apply *Moly Lube* grease to the threads of the puller pressing screw and the center hole of the crankshaft.
4. Install the puller body into the flywheel 50 mm threads at least 6 full turns.
5. If the 50 mm threads of the flywheel are damaged, install the puller flange onto the puller body. Then attach the flywheel puller to the flywheel with three puller screws.
6. Hold the puller body with a wrench, and tighten the pressing screw until the flywheel releases.
7. Turn the center screw and lift the flywheel off of the crankshaft.

Flywheel Installation

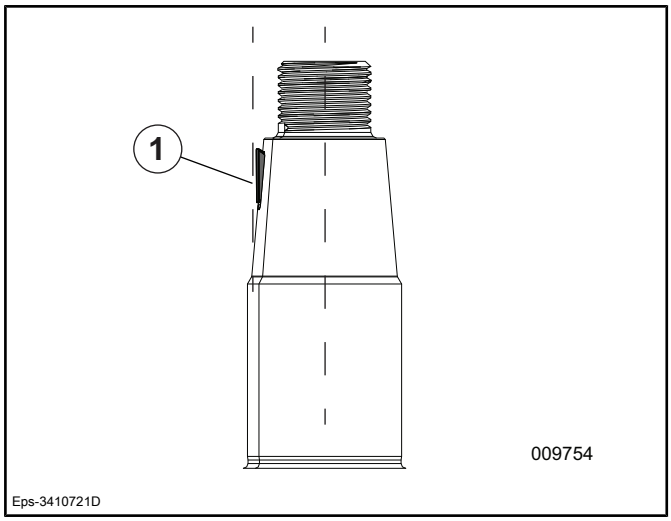
⚠ CAUTION

To avoid injury, keep hands and fingers clear from underside of flywheel. Flywheel can snap toward stator with great magnetic force.

NOTICE

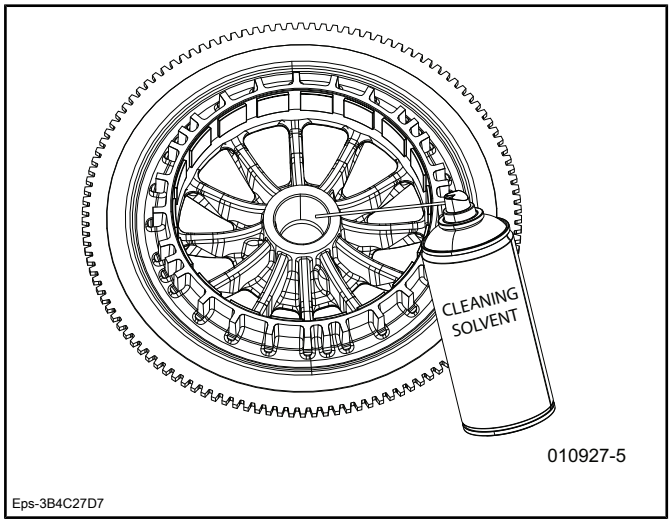
Use a new flywheel nut to install the flywheel.

1. Install the outer edge of flywheel key parallel with center line of crankshaft.



1. Flywheel key

2. Thoroughly clean the crankshaft and flywheel tapers with *Cleaning Solvent* and let dry.



Required Chemical
Nut Lock
P/N 500418

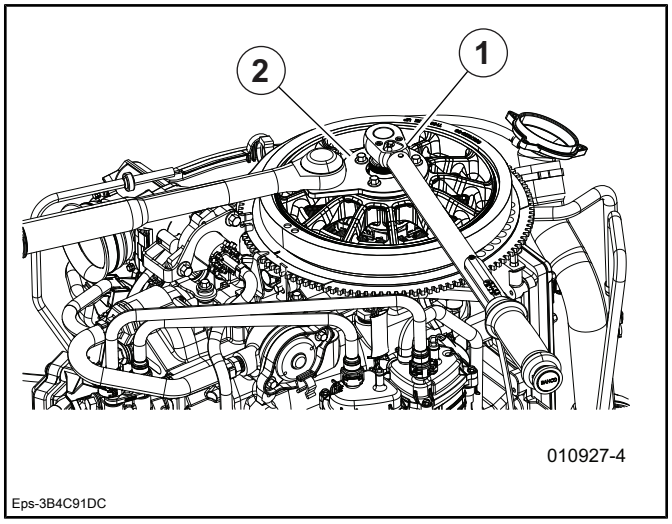
3. Apply a thin, even coat of *Nut Lock* to the inside taper of the flywheel.

IMPORTANT: DO NOT over apply *Nut Lock* on flywheel taper. This prevents *Nut Lock* from migrating into upper seal of crankshaft.

Required Chemical
Gasket Sealing Compound
P/N 508235

Required Tools
Flywheel Holding Tool
P/N 359868
Flywheel Nut Socket
P/N 357715

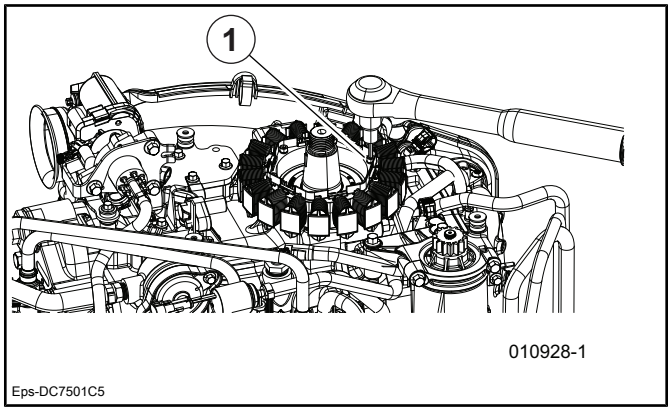
4. Align the flywheel keyway and install the flywheel. Coat the threads of a new flywheel nut with *Gasket Sealing Compound*. Install the nut on the crank shaft threads. Use Flywheel Holding Tool, P/N 359868, with a breaker bar to hold the flywheel. Use Flywheel Nut Socket, P/N 357715, with a torque wrench and tighten the flywheel nut to a torque of 140 to 160 ft. lbs. (190 to 217 N·m).



1. Flywheel Nut Socket, P/N 357715
2. Flywheel Holding Tool, P/N 359868

Stator Service

1. Remove six hex head screws to remove stator.



1. Screws

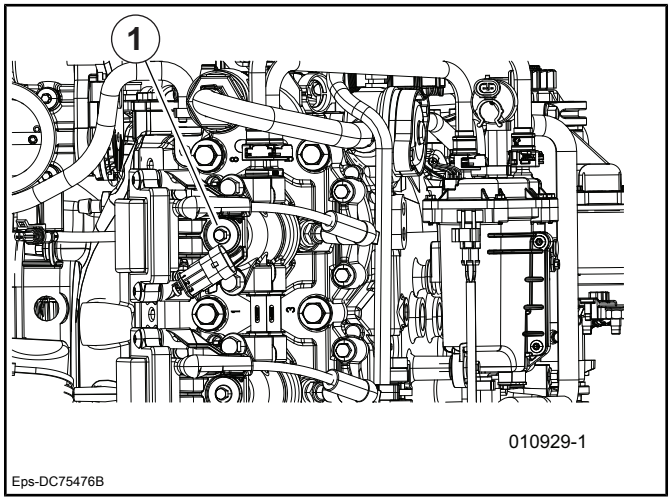
Required Chemical
Nut Lock P/N 500418

2. To install stator, position stator on cylinder block. Apply *Nut Lock* to screw threads. Install screws and tighten in crossing pattern to a torque of 24 to 36 in. lbs. (3 to 4 N·m).

Ignition Coil Servicing

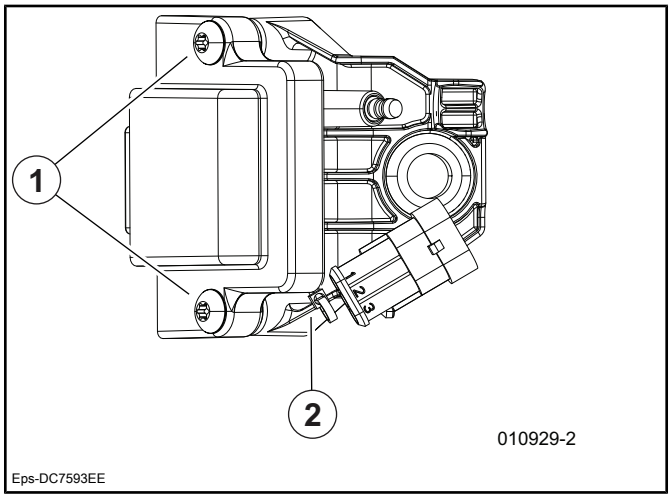
Ignition Coil Removal

1. Remove spark plug lead from the spark plug.
2. Disconnect ignition coil electrical connector.
3. Remove the screw and washer retaining the ignition coil bracket.



1. Screw and washer

4. Make note of wire routing before removing the coil from the mounting bracket. Remove the two screws.



1. Wire routing
2. Screws

Ignition Coil Installation

1. Installation is the reverse of removal.
2. Tighten screws to a torque of 84 to 106 in. lb. (10 to 12 N·m). Install spark plug lead on ignition coil and spark plug. Connect the ignition coil electrical connector.

Timing Adjustments

NOTICE

Make sure the timing pointer is set and the outboard reaches operating temperature BEFORE making any timing adjustments.

Ignition timing is set at the factory and does NOT require routine adjustment.

Check ignition timing after any of the following procedures:

– Powerhead replacement
– Crankshaft replacement
– Flywheel replacement

Timing Pointer

⚠ WARNING

To prevent accidental starting while servicing, remove the key from the key switch. Disconnect the battery cables at the battery.

NOTICE

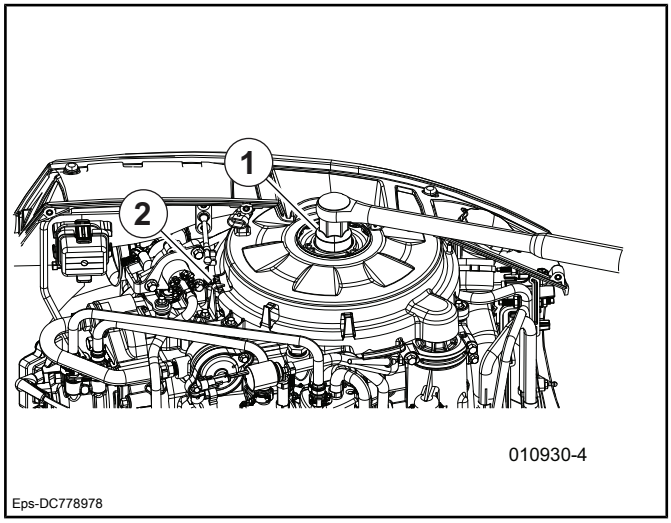
The timing pointer is NOT set at the factory and MUST be set BEFORE making any timing adjustments.

The timing pointer must be adjusted to indicate top dead center (TDC) of the number 1 piston. This reference to the position of the number 1 piston is used to synchronize the electronic timing controlled by the *EMM* with the mechanical position of the number 1 piston.

1. Disconnect the battery cables at the battery.
2. Remove the plugs from the center frame, air duct and flywheel. Remove the spark plugs.

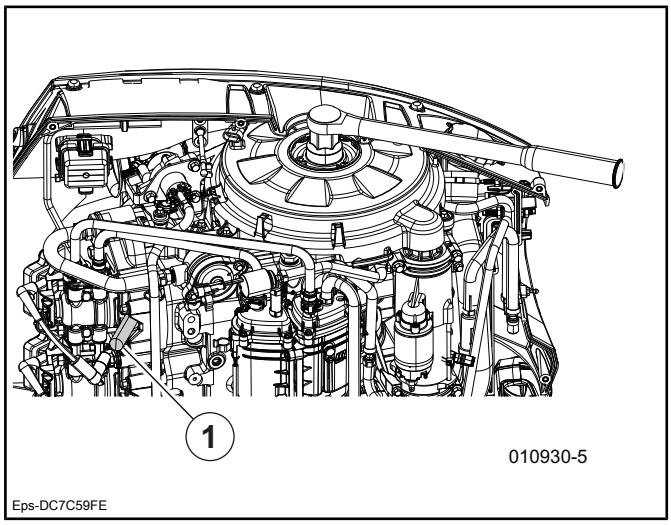
Required Tools
Flywheel Nut Socket P/N 357715
Piston Stop Tool P/N 342679

3. Use Flywheel Nut Socket, P/N 357715, to rotate the flywheel clockwise past the 28° ATDC mark on the flywheel.



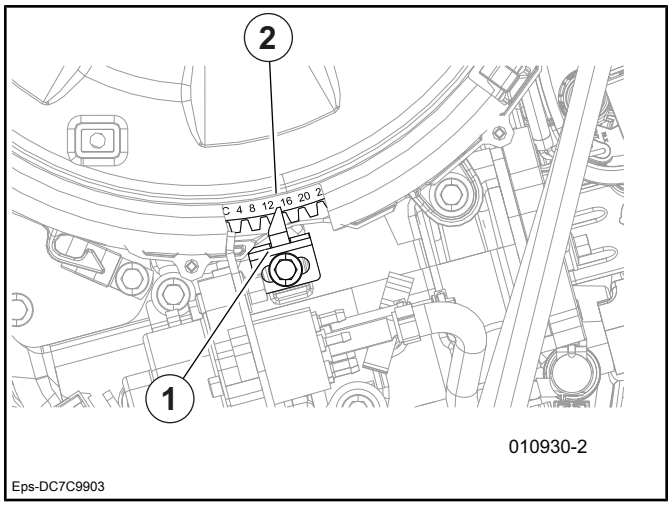
1. Flywheel Nut Socket, P/N 357715
2. Timing pointer

4. Install the Piston Stop Tool, P/N 342679, completely into the spark plug hole of the number 1 cylinder.



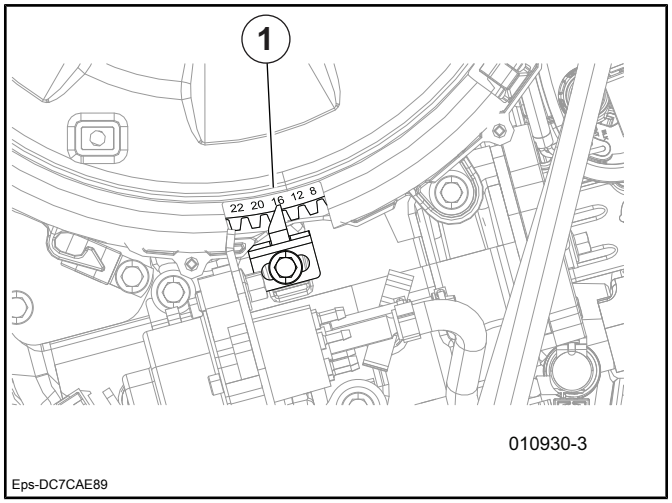
1. Piston Stop Tool, P/N 342679

5. Rotate flywheel counterclockwise until the number 1 piston contacts the tool. Keep pressure on the flywheel to position the piston firmly against the tool. It is NOT necessary to force the piston against the tool.
6. Record the degrees ATDC on the flywheel directly across from the pointer.



1. Timing pointer
2. Record the degrees on the flywheel

7. Rotate the flywheel **clockwise** until the piston contacts the tool.
8. Record the degrees BTDC on the flywheel directly across from the pointer.



1. Record the degrees on the flywheel

9. Add the number of degrees recorded in step 2 to the number of degrees recorded in step 4 to obtain the degree Range. Then divide the Range by 2 to obtain the Result.

Example:		14° ATDC
	+	16° BTDC
Range		30°
	÷	2
Result		15°

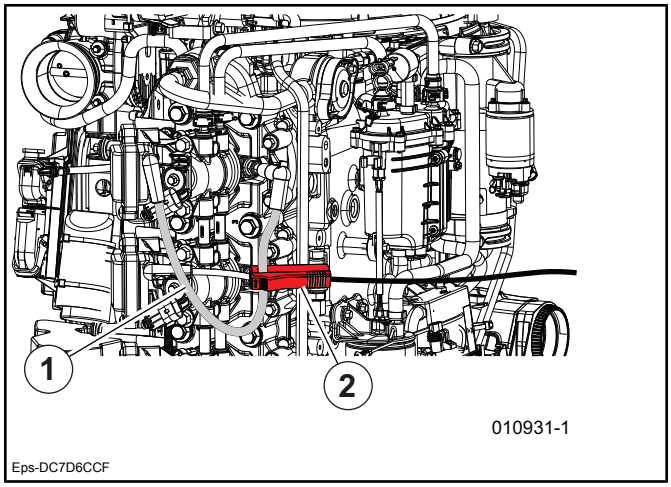
10. With the piston against the tool, adjust the pointer to read the result from Step 9.

11. Rotate the flywheel counterclockwise until the piston contacts the tool. Record the degrees ATDC on the flywheel.
12. Rotate the flywheel clockwise until the piston contacts the tool. Record the degrees BTDC on the flywheel.
13. The timing pointer is correctly centered when the piston contacts the tool at the Step 9 result, at both the ATDC and BTDC positions.
14. Rotate the flywheel counterclockwise slightly to release tool then remove it from spark plug hole.
15. Install the spark plugs. Refer to **Spark Plugs**.

Required Tool
Timing Lead
P/N 587316

16. Install Timing Lead, P/N 587316, onto the #1 cylinder coil and spark plug as shown. Connect the timing light pick up to the timing lead.

IMPORTANT: Keep the timing light pick up a minimum of 2 inches (51 mm) away from the ignition coil during the timing verification procedure.



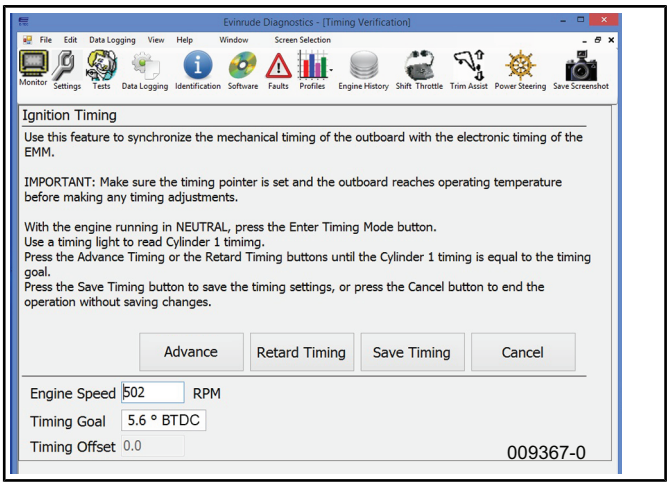
1. *Timing Lead, P/N 587316*
2. *Timing light pick up a minimum of 2 inches (51 mm) away from the ignition coil*

Timing Verification

Use *Evinrude Diagnostics* software to synchronize the mechanical timing of the outboard with the electronic timing of the *EMM*.

Start the outboard.

Use the *Settings/Ignition Timing* screen of the diagnostics software and follow the on-screen instructions.



TIMING ADJUSTMENT SCREEN

When the timing verification procedure is complete, remove the timing lead from cylinder number 1 spark plug and ignition coil. Then reinstall the spark plug lead.

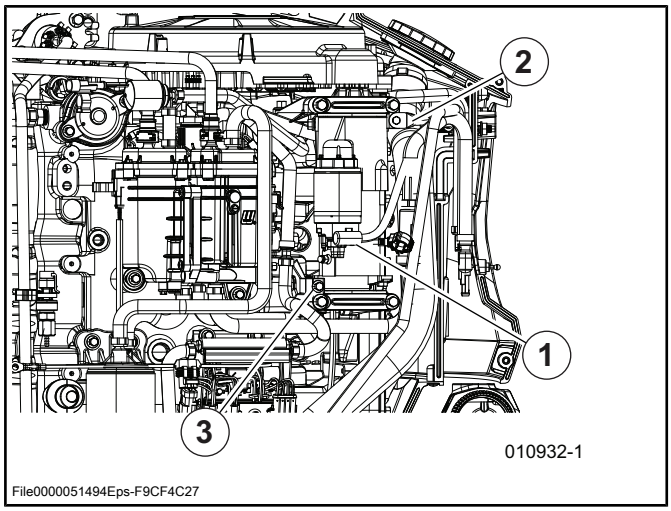
Reinstall the plugs into the flywheel, air duct and center frame.

Electric Starter Servicing

Starter Removal

IMPORTANT: Do not clean the starter drive while the starter motor and drive are installed on the powerhead. The cleaning agent could drain into the starter motor, washing dirt from the drive into the starter bearings and commutator.

1. Disconnect the battery cables at the battery. Disconnect the battery negative (–) cable FIRST. Disconnect the battery positive (**+**) cable LAST.
2. Remove the positive (+) cable from the “B” terminal on the solenoid.
3. Remove the red/tan wire from the “S” terminal on the solenoid.
4. Remove the ground cable from the upper starter mounting bracket.
5. Remove the engine harness ground from the lower starter mounting bracket.



1. Positive (+) cable
2. Ground cable
3. Engine harness ground

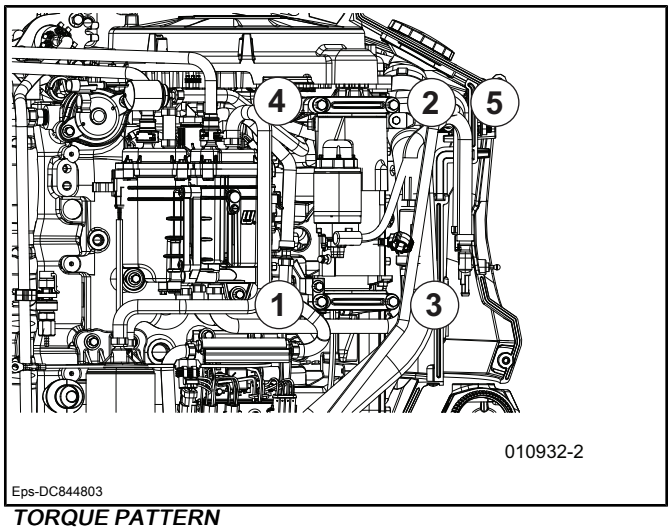
6. First remove the two upper mounting bracket screws and bracket. Then remove the two lower mounting bracket screws and bracket. Then remove the starter.

Starter Installation

1. Apply *Locquic Primer* and *Nut Lock* to the threads of the four starter mounting screws.

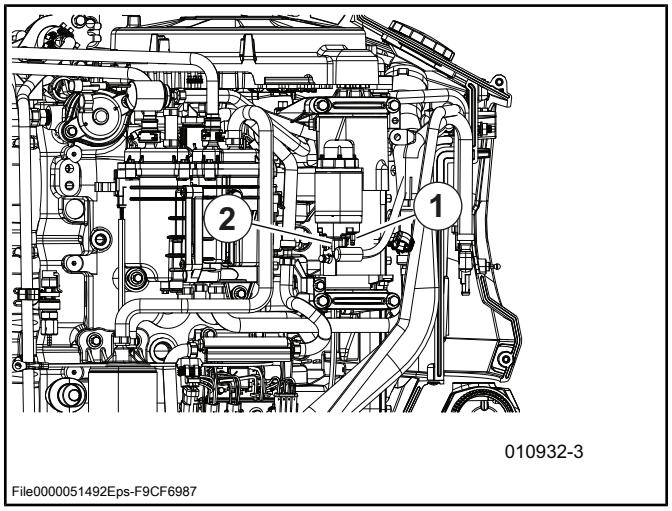
Required Chemical
Nut Lock **P/N 500418**

2. If removed, install the mounting grommets on the starter housing.
3. Position the starter and install the lower mounting bracket with two screws. Then install the upper mounting bracket with two screws.
4. First, hand-tighten all screws. Tighten all screws in the pattern shown to a torque of 17 to 19 ft. lbs. (23 to 25.8 N·m).



TORQUE PATTERN

5. Attach the red/tan wire to the “S” terminal on the solenoid with lock washer and nut; tighten to a torque of 15 to 22 In. lbs. (1.6 to 2.4 N·m).
6. Attach the positive (+) cable to the “B” terminal on the solenoid with lock washer and nut; tighten to a torque of 72 to 96 In. lbs. (8 to 10 N·m).



1. “S” terminal
2. “B” terminal

Required Chemical
No-Ox Grease **P/N 768230**

7. Coat the terminal connections with *No-Ox Grease*, P/N 768230.
8. Reconnect the battery cables at the battery.

IMPORTANT: Connect the battery positive (**+**) cable to the battery positive (**+**) post FIRST. Connect the battery negative (**–**) cable to the battery negative (**–**) post LAST.

Connector Servicing

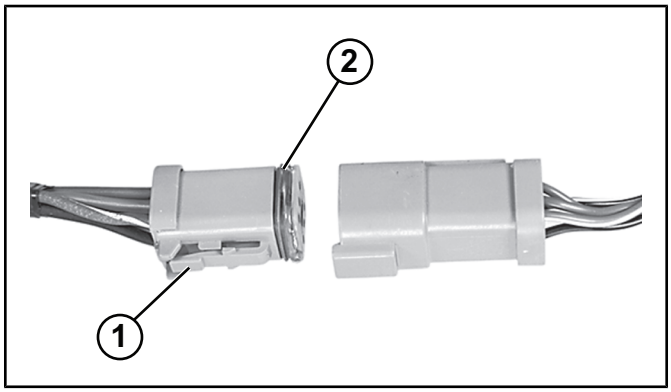
Deutsch Connectors

IMPORTANT: *Dielectric Grease*, P/N 503243 is recommended. Incorrect grease application can cause electrical or warning system problems.

1. Press the latch and pull the connectors apart to disconnect the connector.
2. To connect the connector, confirm that the seal is in place.
3. Clean off any old grease and dirt from connectors.

Required Chemical
Dielectric Grease **P/N 503243**

4. Apply a light coat of Dielectric Grease, P/N 503243, to the seal only.
5. Push connectors together until latched.



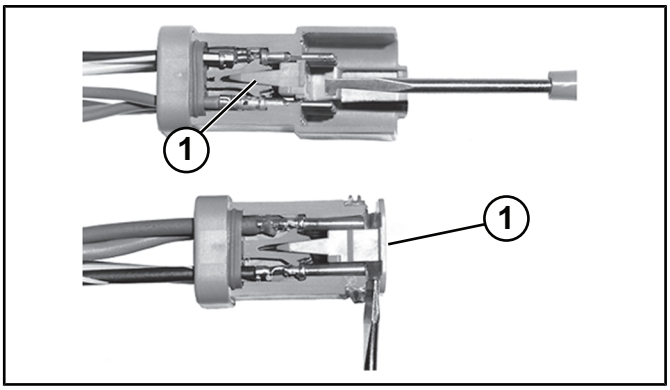
1. Latch
2. Seal

Terminal Removal

1. Use hook-end of Connector Service Tool, P/N 342667, to pull out the lock-wedge from the receptacle.

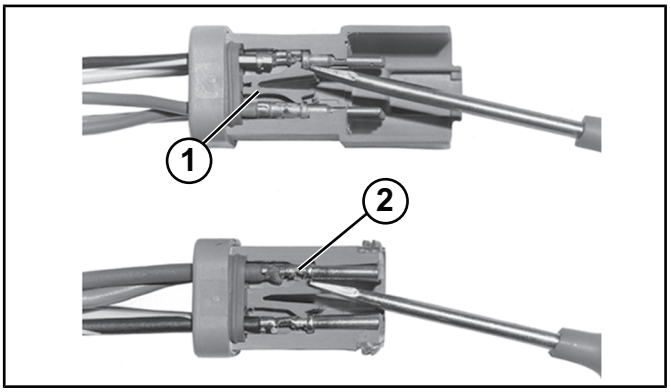
Required Tool
Connector Service Tool **P/N 342667**

2. Use other end of the tool to pry out the lock-wedge from the plug.
3. Use needle-nose pliers to the remove lock-wedge from 3-pin receptacle.



1. Wedge

4. Release terminal latch and gently pull on wire.



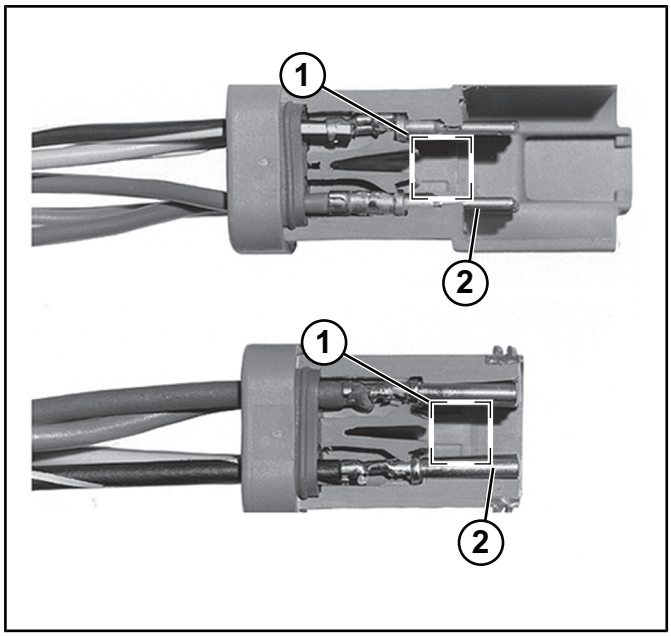
1. Terminal latch (receptacle)
2. Terminal latch (plug)

Terminal Installation

1. Push terminal through seal until it locks into place.

Required Chemical
Dielectric Grease **P/N 503243**

2. Fill the lock-wedge cavity to the end of the plug (approximately 1/32 inch {0.8 mm}), with Dielectric Grease, P/N 503243.



1. *Lock-wedge cavity*
2. *End of plug*

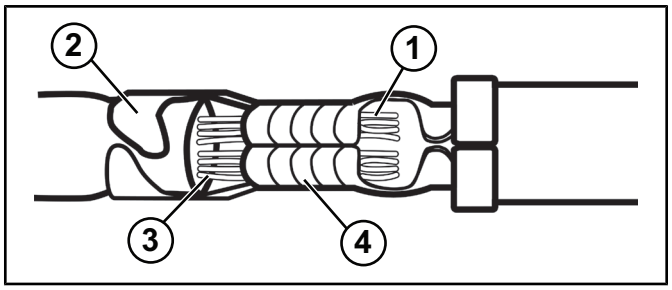
3. Push the lock-wedge in until latched. The wedge in 2-pin receptacle is not symmetrical; position latch shoulders next to terminals.

Crimping Terminals

1. Strip insulation back 3/16 in. (5 mm).

Required Tool
Crimping Pliers **P/N 322696**

2. Place terminal in 18 gauge notch of Crimping Pliers, P/N 322696.
3. Position end of wire strands in terminal past wire crimp area, and position end of insulation past insulation crimp area.
4. Capture all wire strands in crimp; leave no loose strands.
5. Crimp wire securely. Do not solder.
6. Crimp insulation in 14/16 gauge notch of crimping pliers.



1. *End of wire strands*
2. *Insulation crimp area*
3. *End of insulation*
4. *Wire crimp area*

AMP Connectors

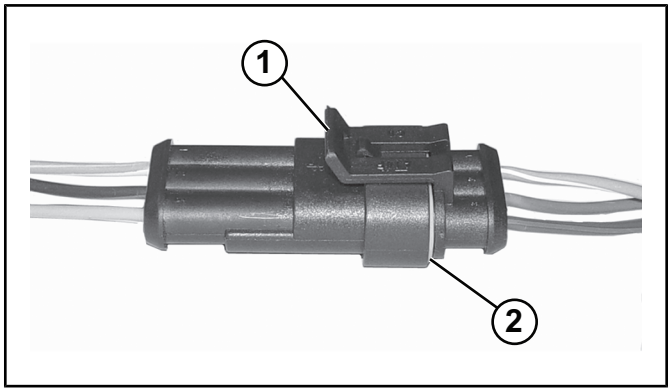
IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals. Dielectric Grease is NOT used on AMP connectors.

Disconnect

1. Lift latch.
2. Pull connectors apart.

Connect

1. Confirm the seal is in place.
2. Push connectors together until latched.



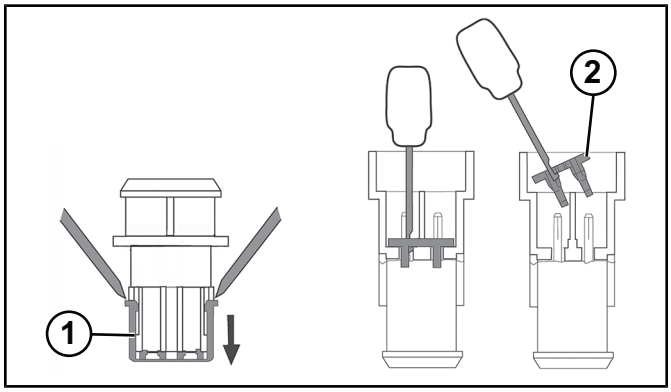
1. *Latch*
2. *Seal*

Terminal Removal

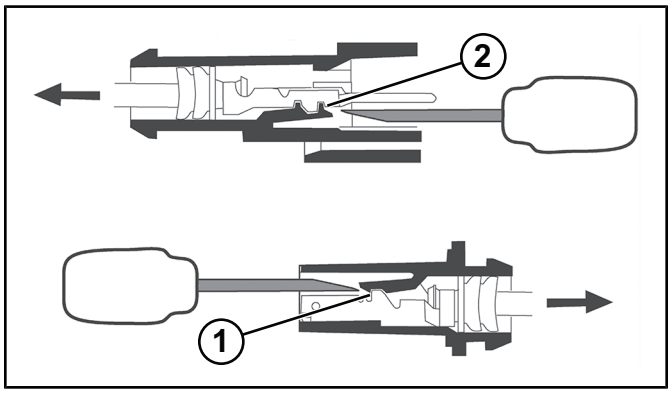
1. Use Secondary Lock Tool, P/N 777078, to release the locking device of the connector housing.

Required Tools
Secondary Lock Tool **P/N 777078**
Primary Lock Tool **P/N 777077**

2. Use Primary Lock Tool, P/N 777077, to release locking tab of connector housing.
3. Release locking tab and pull on wire to remove from connector housing.



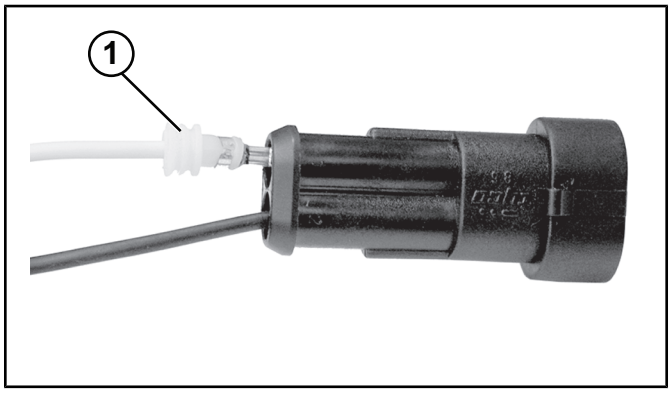
1. Locking device, plug
2. Locking device, receptacle



1. Locking tab, plug
2. Locking tab, receptacle

Terminal Installation

1. Align terminal with connector housing. Push connector and seal into housing until seated.



1. Terminal and seal

2. Align locking device with connector housing and terminals.

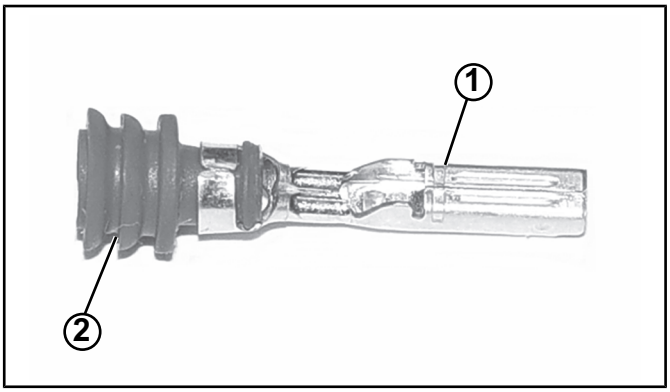
Required Tool
Secondary Lock Installer **P/N 777079**

3. Use Secondary Lock Installer, P/N 777079, to seat device in connector.

Crimping Terminals

1. Crimping *Superseal 1.5* terminals requires *AMP* Crimp Tool with dies, P/N 777281.

Required Tool
Crimp Tool With Dies **P/N 777281**



1. Terminal
2. Seal

Packard Connectors

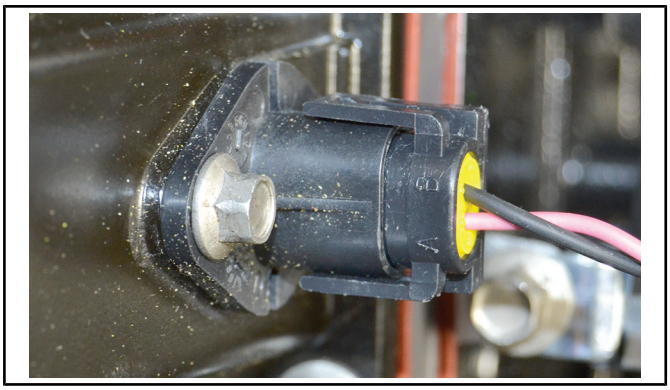
IMPORTANT: Always use the appropriate meter test probes and adapters when testing components fitted with these terminals.

Disconnect

1. Lift latch(es).
2. Remove connector.

Connect

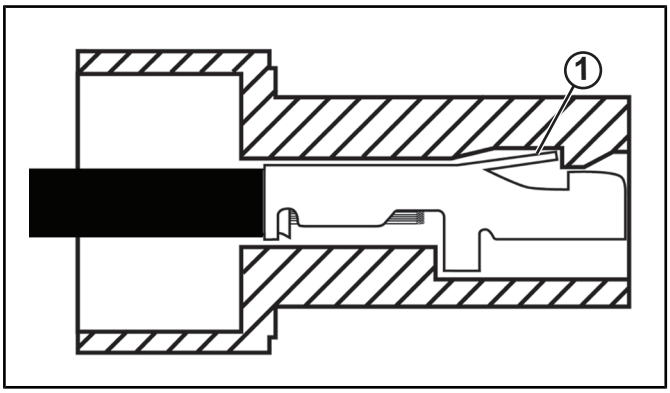
1. Confirm the seal is in place.
2. Push connector onto housing until latched.



Terminal Removal

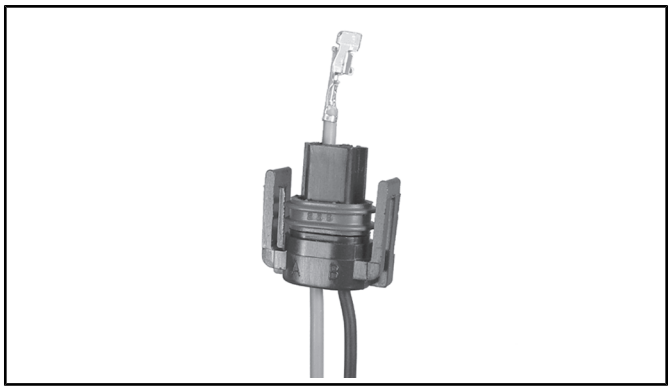
A tab on the back side of the terminal engages a shoulder in the connector housing to hold the terminal in place.

1. Release the tab.
2. Push the terminal and wire through the connector housing.
3. Insert a thin tool into the connector above the terminal to release the tab.



Terminal Installation

1. Install the wire gasket onto the wires and feed the wires through the correct terminal position of the connector housing.
2. Crimp the terminal onto the wire.
3. Pull the wire back into the connector housing until the locking tab engages and the terminal is seated.



Crimping Terminals

1. Strip insulation back 3/16 in. (5 mm).
2. Position end of wire strands in terminal past the wire crimp area and the end of insulation in the insulation crimp area of the terminal.
3. Capture all wire strands in crimp.

NOTE: Do not leave any loose wire strands.

4. Crimp wire and insulation securely using crimping pliers.

Notes

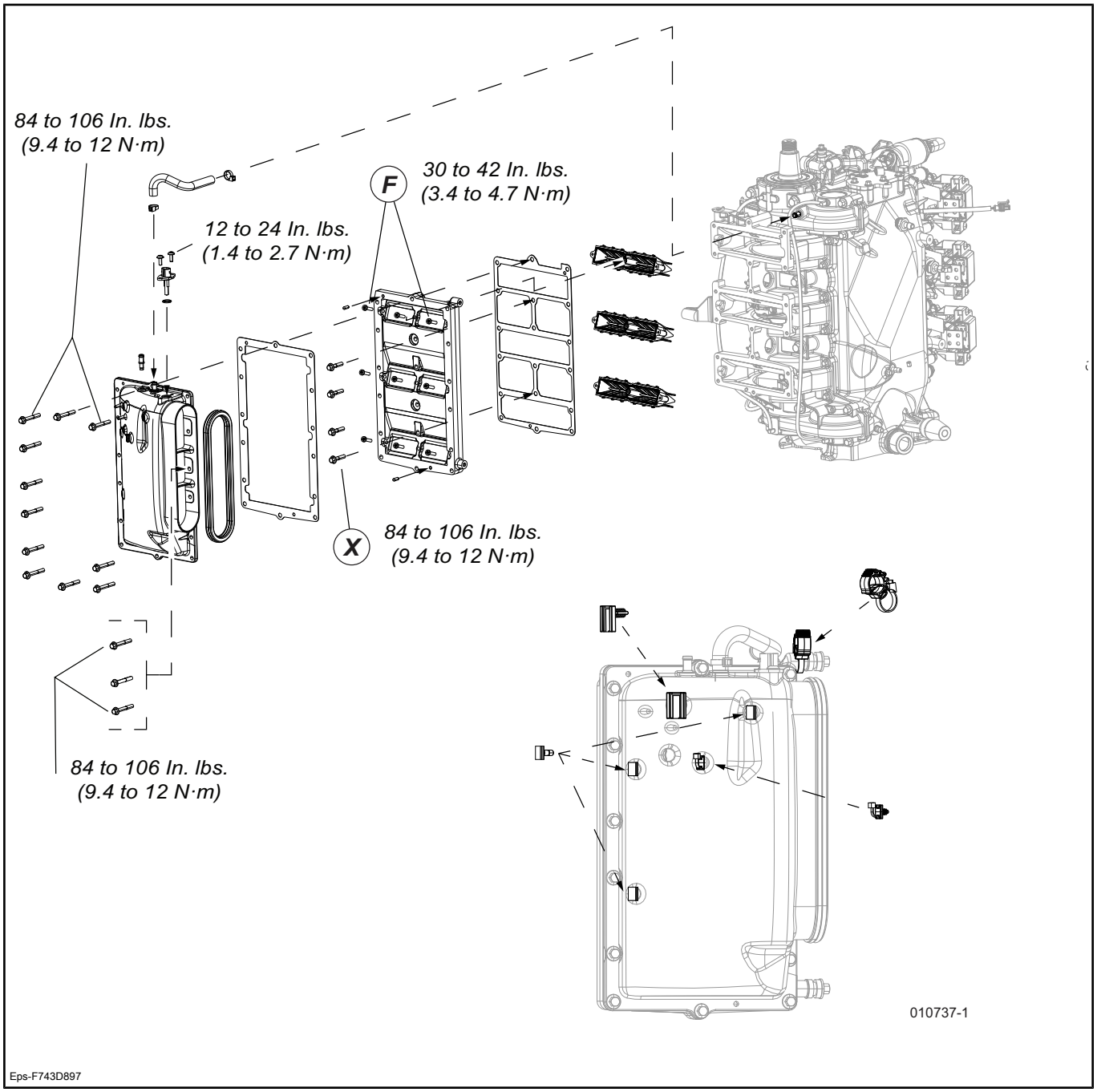
Technician's Notes

Related Documents

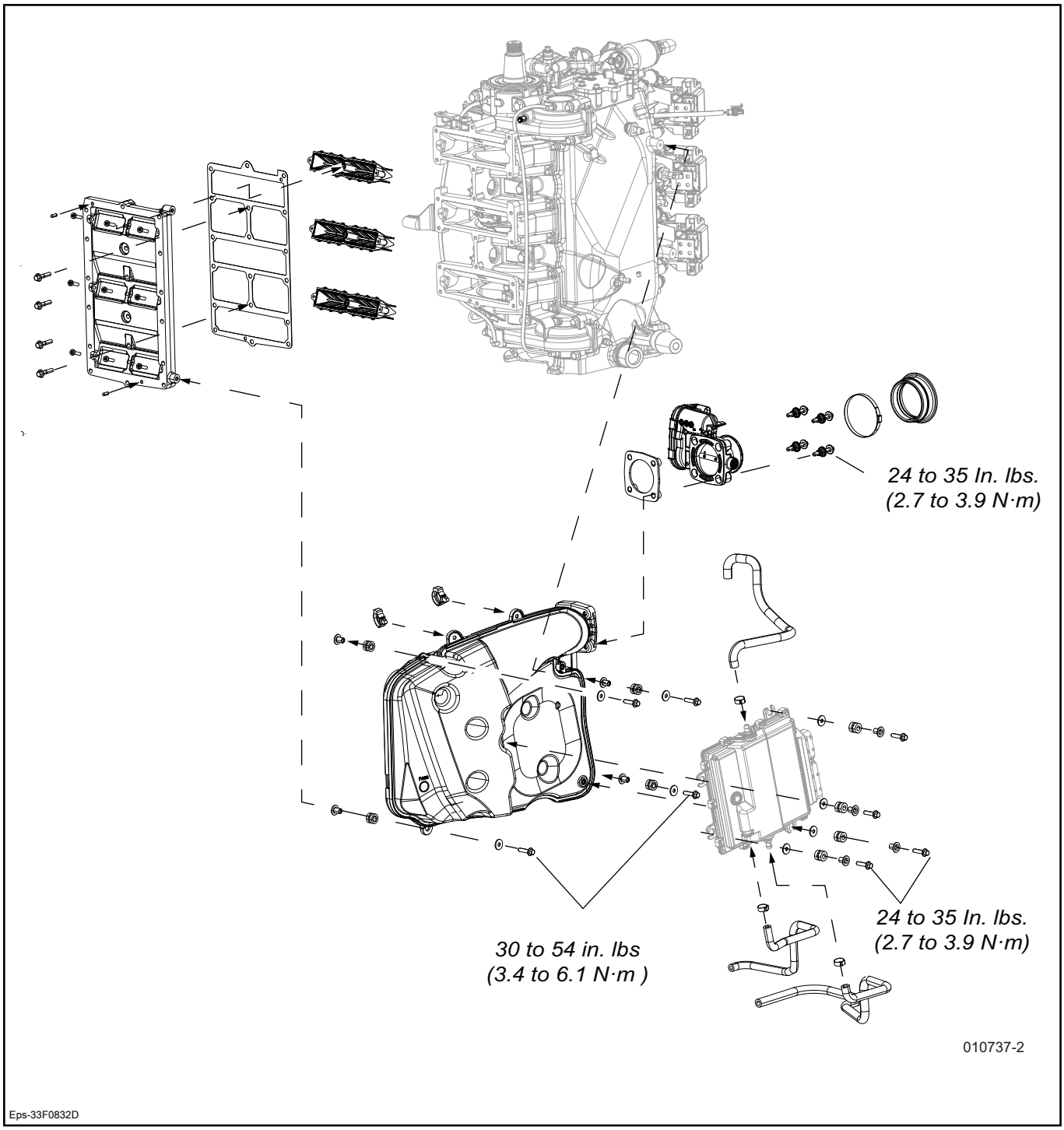
Bulletins	
Instruction Sheets	
Other	

Fuel System

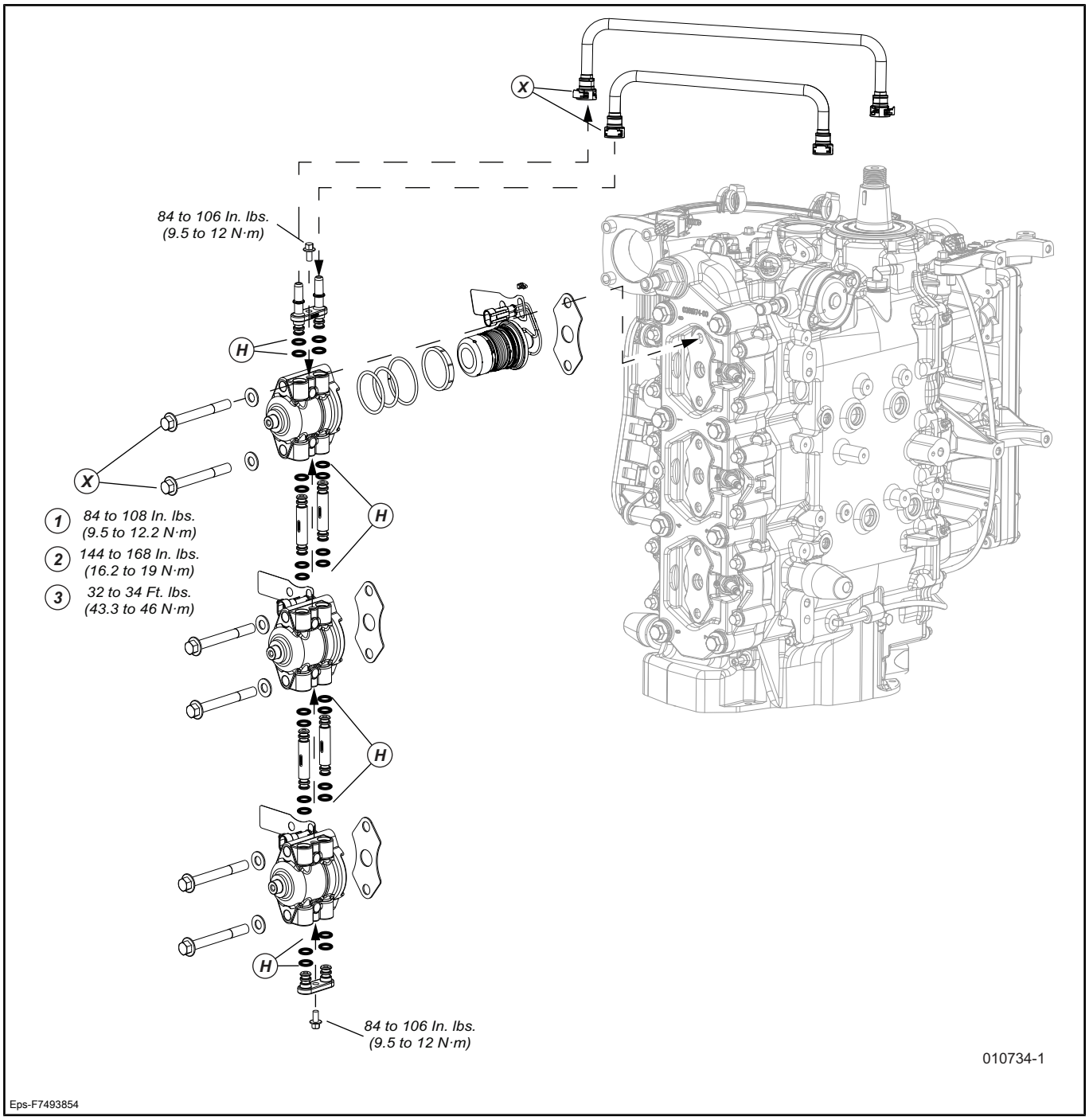
Service Charts: Reed Plate Assembly and Throttle Body



F	Nut Lock	***X***	See Service Manual procedure


24 to 35 In. lbs.
(2.7 to 3.9 N·m)
30 to 54 in. lbs
(3.4 to 6.1 N·m)
24 to 35 In. lbs.
(2.7 to 3.9 N·m)
010737-2
Eps-33F0832D

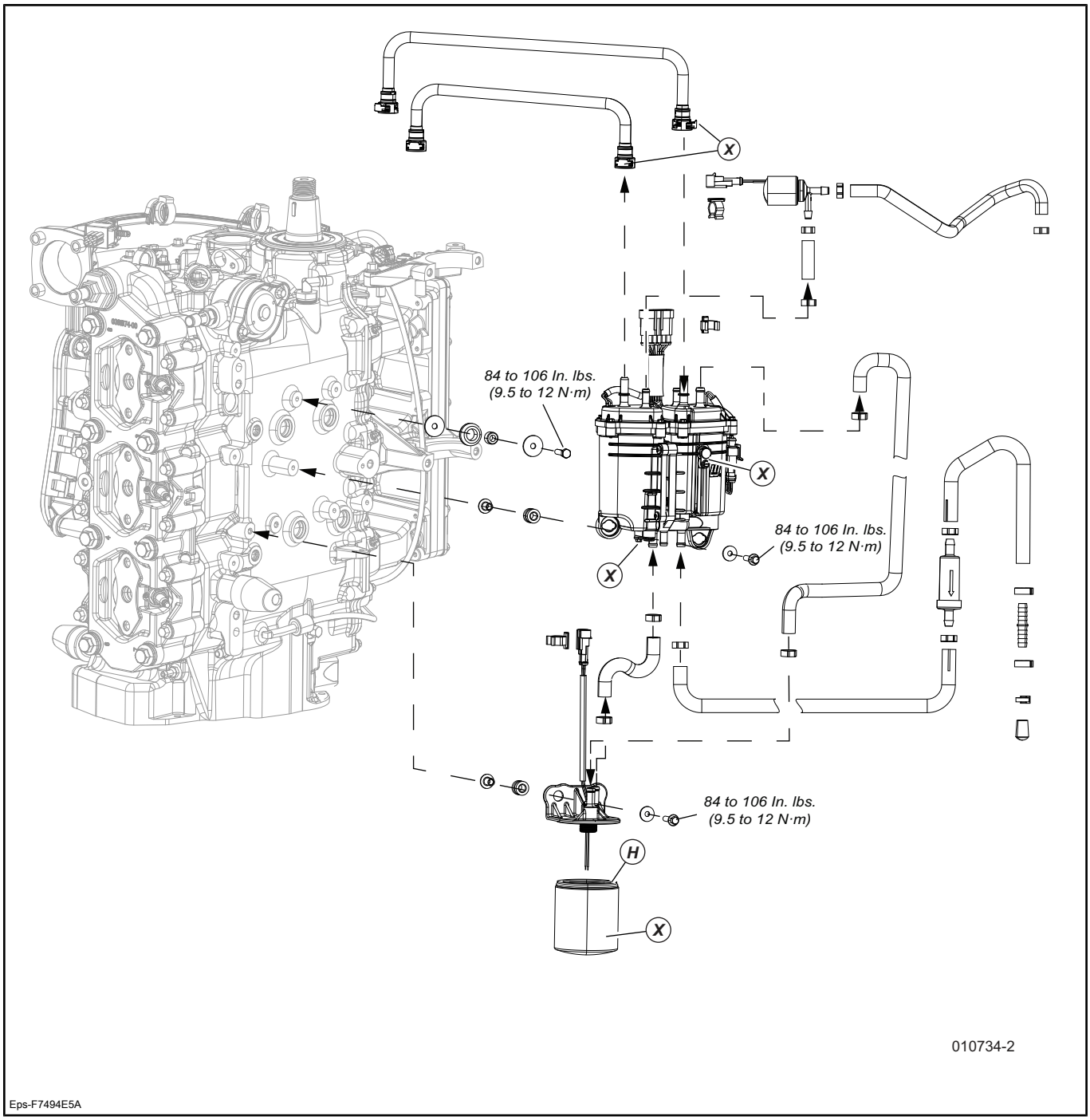
Service Charts: Fuel Filters, Fuel Pump / Vapor Separator, Fuel Rails and Fuel Injectors



Eps-F7493854

H	Outboard Lubricant	***X***	See Service Manual procedure

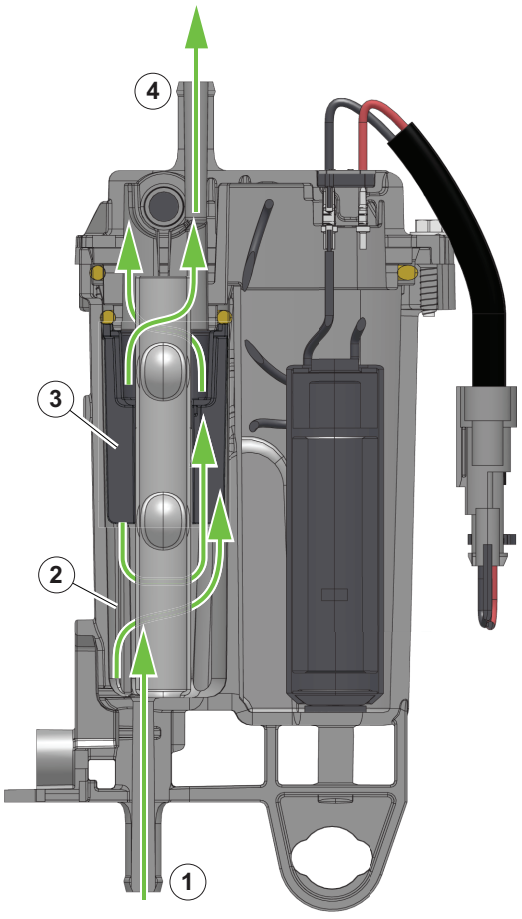
7



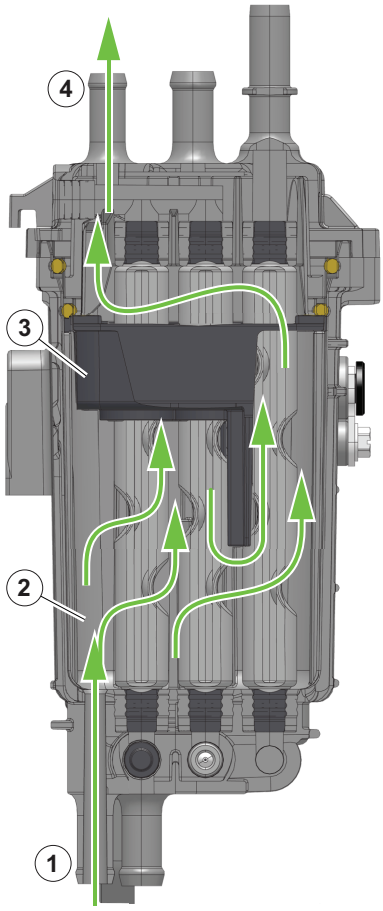
H	Outboard Lubricant	***X***	See Service Manual procedure

Fuel System Flow Diagram

Cooling Water Flow: Cooling water enters the Vapor Separator Assembly thru a fitting (1) on the bottom of the Vapor Separator Assembly and fills the cooling chamber (2). A baffle (3) helps to circulate the water and the water exits through a fitting (4) on the top of the Vapor Separator Assembly.



FRONT VIEW



SIDE VIEW

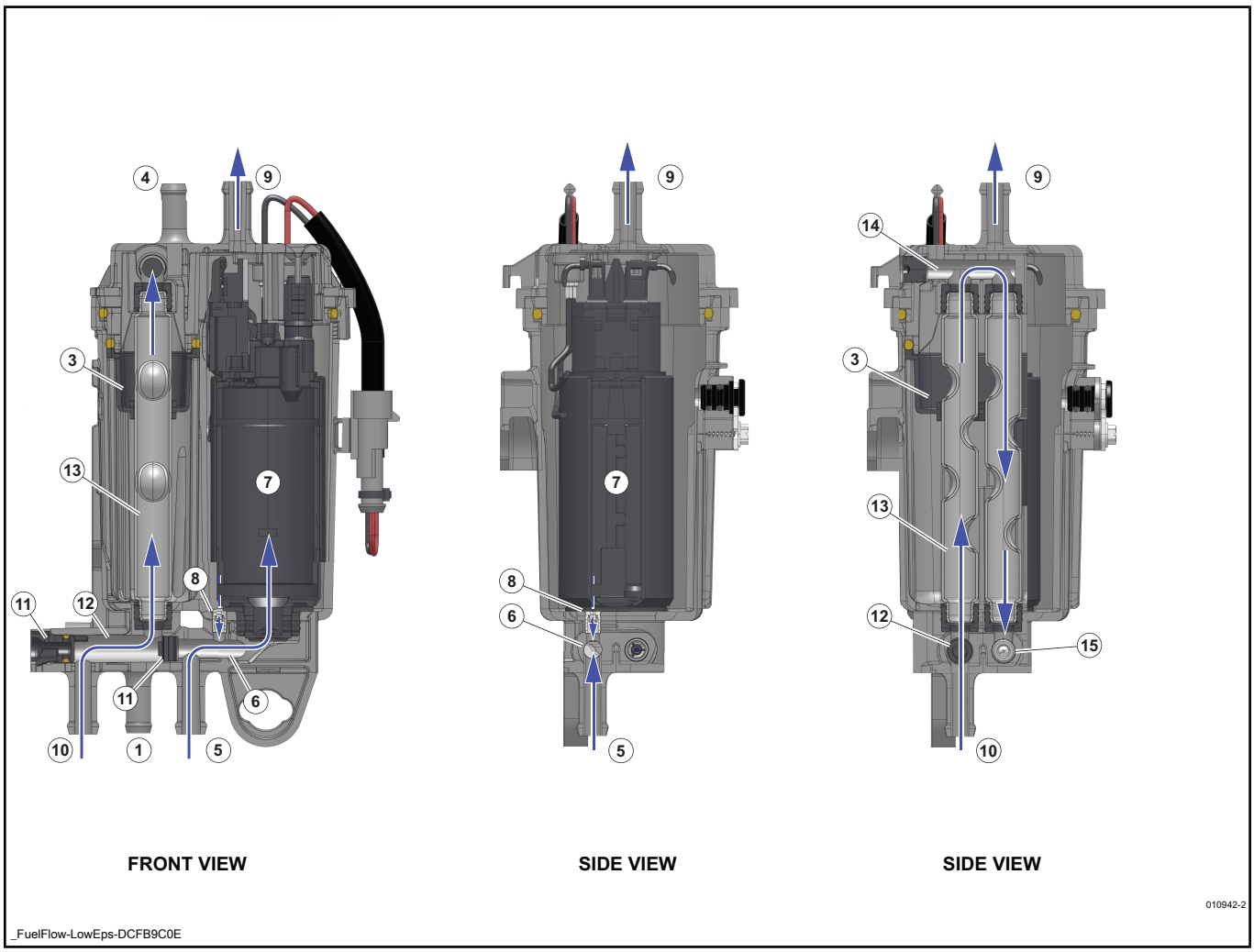
010942-1

_VSACoolingEps-DCFC2EFB

Fuel Flow Low Pressure: Fuel enters through the fuel inlet (5) at the bottom of the Vapor Separator Assembly and flows through an internal passage (6) to the low-pressure fuel pump (7). A relief valve (8) provides over-pressure relief in the event of a restriction in the fuel lines to/from the water separating fuel filter. Fuel flows from the low pressure outlet (9), to the water separating fuel filter.

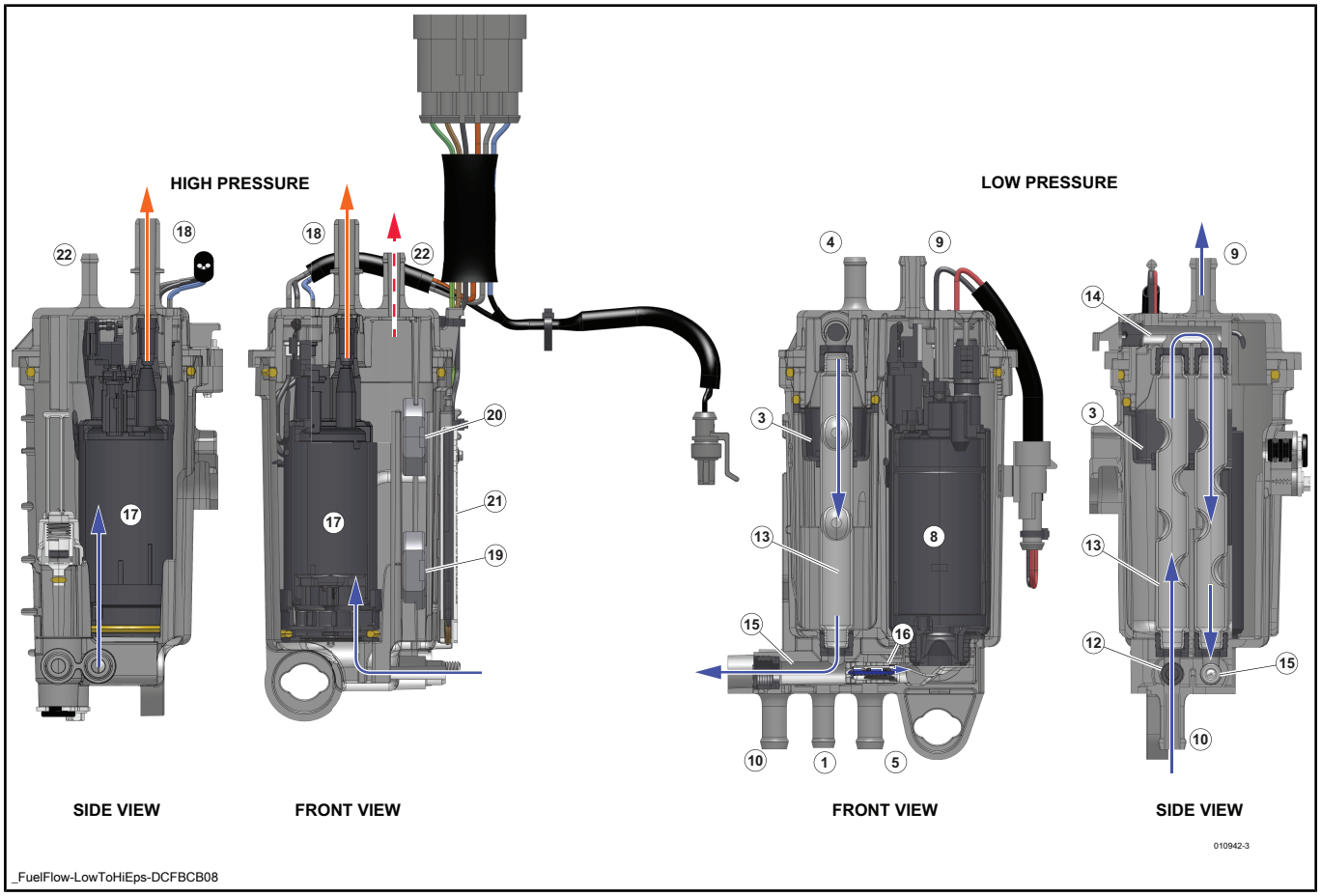
After passing through the water separating fuel filter, filtered fuel flows into a fitting (10) at the bottom of the Vapor Separator Assembly, two plugs (11) direct fuel through an internal passage (12) into the fuel cooling tubes (13).

Fuel flows through the first fuel cooling tube (13), through an internal passage (14) into a second fuel cooling tube and into an internal passage (15).

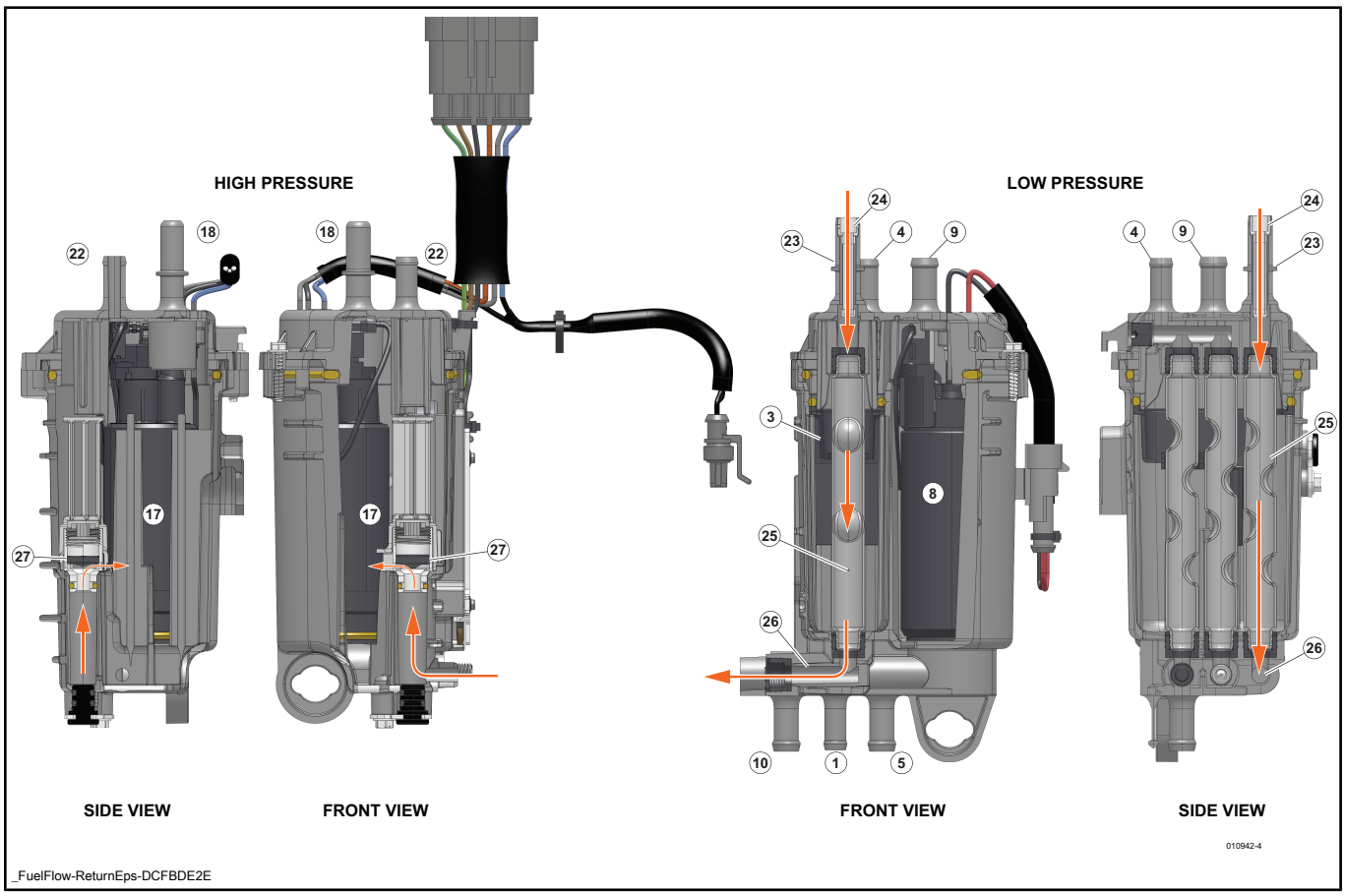


Fuel Flow Low to High Pressure: Fuel flows through this passage (15) from the low pressure side of the Vapor Separator Assembly into the high pressure side of the Vapor Separator Assembly. A pressure relief valve (16), regulates low pressure fuel to 12 to 15 psi (83 to 103 kPa). An electric fuel pump (17) boosts fuel pressure to 28 ± xx psi (193 ± xx kPa). High pressure fuel exits the Vapor Separator Assembly through a fitting (18), flowing through the supply fuel rail to the fuel injectors.

A LOW FUEL float (19) and HIGH FUEL float (20) are used with a sensor (21) to monitor fuel level in the Vapor Separator Assembly. The EMM monitors the sensor and activates the fuel vapor solenoid as needed. Fuel vapor exits the Vapor Separator Assembly through a fitting (22) and is expelled into the intake air plenum.



Fuel Flow High Pressure to Return: Fuel from the fuel injectors returns to the Vapor Separator Assembly through the return fuel rail entering the low pressure side of the Vapor Separator Assembly through a fitting (23) and return filter (24). Returned fuel passes through a fuel cooling tube (25), into an internal passage (26) where it flows into the high pressure side of the Vapor Separator Assembly. Fuel passes through a pressure regulator (27), into the high pressure fuel pump chamber and is circulated to the fuel injectors.



Fuel System Requirements

Regulations and Guidelines

Vessel manufacturer, and/or installer of an EPA certified outboard, must meet minimum specifications for boat fuel systems established by:

U.S. Environmental Protection Agency (EPA)
- 40 CFR 1045.112
- 40 CFR 1060

U.S. Coast Guard (USCG)
- 33 CFR 183

American Boat and Yacht Council (ABYC)
- Standard H-24
- Standard H-25

Permanent Fuel Tanks

Permanent fuel tanks must be properly vented outside of the hull.

Remote fuel tank gas fills must be grounded.

Fuel tank pickups should include an anti-siphon valve to prevent fuel flow if a leak occurs in the fuel distribution system.

Portable Fuel Tanks

NOTICE

Do not use portable fuel tanks for outboards larger than 115 HP. Inadequate fuel flow to high horsepower outboards can result in serious powerhead damage.

Fuel Flow Requirements

	115 HP and Greater
Fuel tank pickup tube; minimum I.D.	3/8 in. (9.5 mm)
Fuel fittings; minimum I.D.	9/32 in. (7.1 mm)
Fuel supply hoses; minimum I.D.	3/8 in. (9.5 mm)
Fuel tank pickup screen	100 mesh, 304 grade stainless steel wire, 0.0045 in. wire diameter, 1 in. (25 mm) long
Anti-siphon valve	2.5 in. (63.5 mm) Hg maximum pressure drop at 30 gph (114 l/hr) flow
Remote fuel filter	0.4 in. Hg maximum pressure drop at 20 gph (76 l/hr) flow, 150 $in.^2$ (1290 cm^2) of filter area
Maximum fuel pump lift height	Fuel pump should not be located more than 30 in. (76.2 cm) above bottom of fuel tank

Recommended Fuel

Use unleaded gasoline with an AKI (R+M)/2 octane rating of 87, or an RON octane rating of 90.

Fuel blending varies by country and region. Your outboard has been designed to operate using the recommended fuels; however, be aware of the following:
- The boat's fuel system may have different requirements regarding the use of alcohol fuels. Refer to the boat's owner guide.
- Alcohol blended fuels attract and hold moisture which may lead to fuel phase separation and can result in engine performance problems or engine damage.
- Use of fuel containing alcohol above the percentage specified by government regulation can result in the following problems in outboard engines and fuel system components:
- Vapor lock or fuel starvation
- Starting and operating difficulties
- Deterioration of rubber or plastic parts
- Corrosion of metal parts
- Damage to internal engine parts
- Inspect for fuel leaks or other fuel system abnormalities if you suspect the presence of alcohol in gasoline exceeds the current government regulation limits.

Use in North America

NOTICE

Do NOT use fuel from fuel pumps labeled E85. Never experiment with other fuels.

The use of unleaded gasoline containing alcohol above the percentage specified by government regulations is not recommended.

Use of fuel labeled E15 is prohibited by U.S. EPA Regulations.

Use of a boat mounted water separating fuel filter, such as Fuel Filter Kit P/N 174176, is strongly recommended.

Biobutanol Blended Fuel

Biobutanol is a four-carbon alcohol produced from renewable, plant-derived energy sources in a fermentation process similar to beer and wine production. Biobutanol delivers more renewable energy content than ethanol while remaining compatible with current vehicles, boats, and infrastructure. Biobutanol does not phase separate in the presence of water like ethanol and is less corrosive to fuel system components such as fuel tanks, fuel fittings and fuel hoses.

Biobutanol blended fuel (either isobutanol or nbutanol) may be used in all *Evinrude* outboards. Use of biobutanol blended fuel will NOT void the warranty of *Evinrude* outboards.

Biobutanol blended fuel (Bu16 - up to 16.1% by volume) has been approved for use by the *National Marine Manufacturers Association (NMMA)*.

Also see Service Bulletin 2015-13(S).

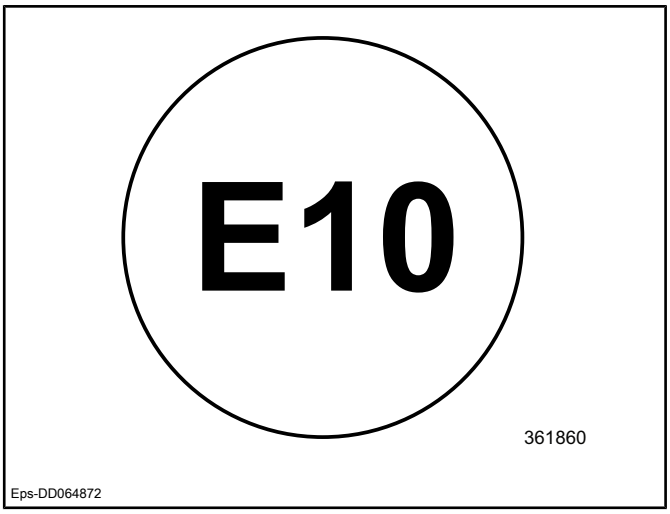
Use Outside of North America

The use of unleaded gasoline containing alcohol above the percentage specified by local government regulations is not recommended.

Use of a boat mounted water separating fuel filter, such as Fuel Filter Kit P/N 174176, is strongly recommended.

Use In the European Union

Deployment of Alternative Fuels Infrastructure Directive 2014/94/EU. This directive provides harmonized labeling across Europe to effectively assist consumers in identifying the compatibility of fuels supplied at refueling points with an engine. All *Evinrude* outboards are compatible with up to 10% ethanol fuel blends (E10). The decal shown below should be present near the fuel filler cap of all recreational vessels.



Additives

IMPORTANT: The only fuel additives approved for use in *Evinrude* outboards are *2+4* fuel conditioner and *Evinrude* Fuel System Cleaner. **Use of other fuel additives can result in poor performance or engine damage**.

***Evinrude 2+4* Fuel Conditioner** will help prevent gum and varnish deposits from forming in fuel system components and will remove moisture from the fuel system. It can be used continuously and should be used during any period when the outboard is not being operated on a regular basis. Its use will reduce spark plug fouling, fuel system icing, and fuel system component deterioration.

***Evinrude* Fuel System Cleaner** will help keep fuel injectors in optimal operating condition.

Components

The fuel system includes the following components:

- Inline fuel filter (65 micron)
- Fuel Pump and Vapor Separator Assembly
- Water Separating Fuel Filter
- Fuel Supply Rail
- Fuel Injectors
- Fuel Return Rail
- Fuel Vapor Vent Solenoid

Fuel Pump and Vapor Separator Assembly

The fuel pump and vapor separator assembly houses the following fuel system components in one package:

- Electric fuel lift pump
  - gerotor pump
  - runs with Pulse Width Modulation (PWM)
  - functions as the fuel lift pump
  - functions to raise fuel pressure
- Vapor separator assembly
  - water-cooled fuel reservoir to accumulate incoming fuel from the fuel lift pump and from the fuel return rail
  - micro switches control venting of fuel vapors
  - Low pressure regulator
  - High pressure regulator
- Electric fuel circulation pump
  - turbine impeller pump
  - runs 100% duty cycle
- Filter (fuel return rail fitting)

Electric Lift Pump

The electric fuel lift pump utilizes a gerotor for maximum lifting performance.

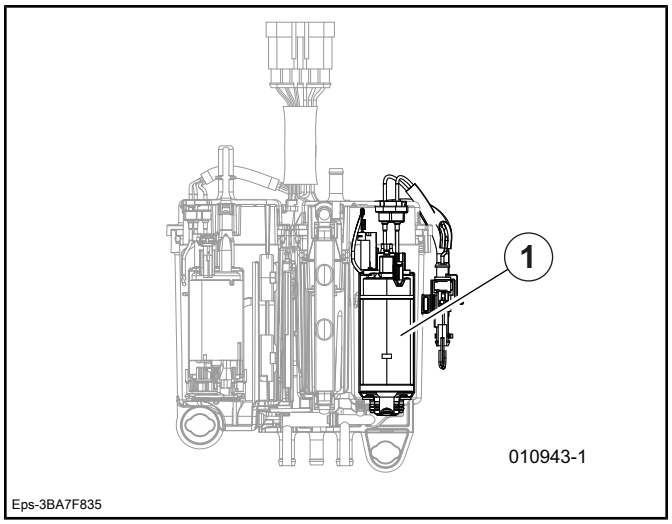
Fuel Supply

The pump is mounted inside the vapor separator and draws fuel from the boat fuel tank through an in-line 65 micron filter.

Fuel is pressurized to 7 to 17 psi (48 to 117 kPa) and flows through a hose to a 10 micron water separating fuel filter and into the fuel reservoir.

Electrical Circuit

The electric fuel lift pump is controlled by the *EMM* and operates on the 12 V circuit. The pump activates for 10 seconds when the *EMM* powers up (assumes the fuel system is primed, see **Fuel System Priming**). The fuel pump runs continuously during engine operation.



1. Electric fuel lift pump

The *EMM* monitors the fuel pump electrical circuit.

- If the pump is disconnected (open circuit), the *EMM*

Stores fault code 157

Engine Monitor CHECK ENGINE display: ON

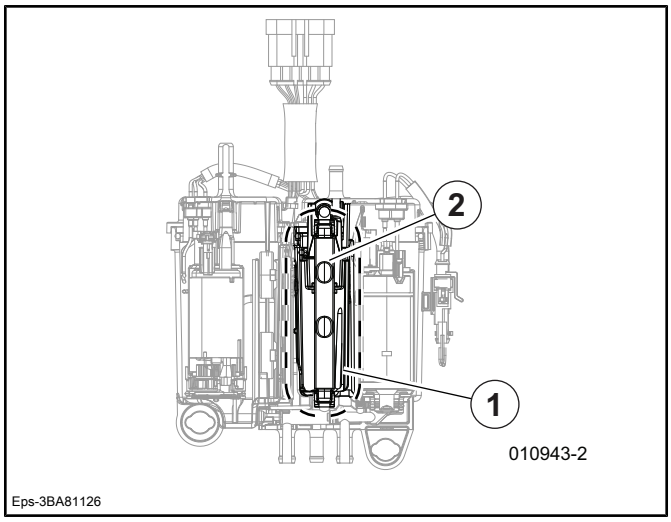
- If the circuit current is beyond the specified range (short circuit), the EMM:

Stores fault code 158

Engine Monitor CHECK ENGINE display: ON

Cooling

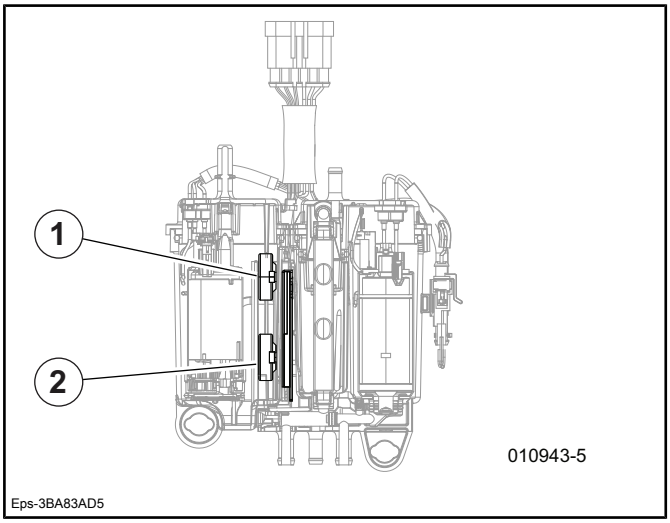
Water is used to cool the fuel as it flows through the vapor separator. The cooling passage of the separator self-drains when the outboard is stored vertically.



1. *Fuel reservoir*
2. *Cooling passage*

Fuel Level

The fuel level in the reservoir is regulated by the fuel level sensor.



1. *Upper fuel level micro switch (approximate location)*
2. *Lower fuel level micro switch (approximate location)*

Electrical Circuit

The *EMM* monitors the fuel level micro switches.

The upper micro switch is CLOSED when the vapor separator is full and OPEN when it is not full.

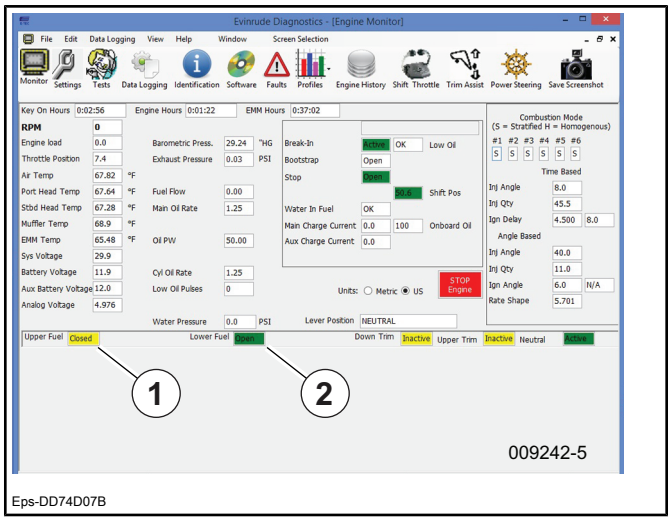
The lower micro switch is OPEN when the vapor separator is full and CLOSED when it is not full.

When the upper micro switch closes, the *EMM* closes the fuel vapor vent solenoid, preventing vapor and fuel from escaping.

When the lower micro switch closes, the *EMM* opens the fuel vapor vent solenoid, allowing vapor to escape, and the fuel lift pump goes to 100% duty cycle to add fuel to the reservoir.

The *EMM* controls the vapor vent solenoid operation by Pulse Width Modulation (PWM). PWM is a method of powering an analog device (the vapor vent solenoid) using a digital source (the EMM). PWM is often expressed as a duty cycle which describes the amount of time the signal is ON. An 80% duty cycle (higher) is ON more than a 30% (lower) duty cycle.

Use *Evinrude Diagnostics* software, v 6.4 or higher to observe the micro switch and vapor vent solenoid operation.



1. *Upper fuel micro switch*
2. *Lower fuel micro switch*

Modes of Operation

Initial Key ON / Engine OFF

Upper micro switch: OPEN

Lower micro switch: CLOSED

- Lift pump and circulation pump run 10 seconds
- Lift pump runs for an additional 50 seconds
- Vapor vent solenoid OPEN - PWM in prime mode (higher duty cycle) and allows the vapor separator to fill quickly

Upper micro switch: OPEN

Lower micro switch: OPEN

- Vapor separator not completely full
- Lift pump continues to run
- Vapor vent solenoid OPEN - PWM in purge mode (lower duty cycle) allowing the vapor separator to continue to fill

Upper micro switch: CLOSED

Lower micro switch: OPEN

- Vapor separator full
- Lift pump ON
- Vapor vent solenoid CLOSED

Key ON / Engine Running

Upper micro switch: OPEN

Lower micro switch: CLOSED

- Vapor separator close to empty
- Vapor vent solenoid OPEN - PWM in prime mode (higher duty cycle) and allows the vapor separator to fill quickly.

Upper micro switch: OPEN

Lower micro switch: OPEN

– Vapor separator not completely full
– Lift pump continues to run
– Vapor vent solenoid OPEN - PWM in purge mode (lower duty cycle) allowing the vapor separator to continue to fill

Upper micro switch: CLOSED

Lower micro switch: OPEN

– Vapor separator full
– Lift pump ON
– Vapor vent solenoid CLOSED

Fault Codes

If the upper micro switch circuit voltage is disconnected (open circuit), the *EMM*:

– Activates S.A.F.E.
– Stores fault code 132
– Engine Monitor CHECK ENGINE display: ON

If the lower micro switch circuit voltage is disconnected (open circuit), the *EMM*:

– Stores fault code 133
– Engine Monitor CHECK ENGINE display: ON

If the lower micro switch remains closed beyond the specified range (5 seconds) {assumes the fuel system is primed — engine is running out of fuel}, the *EMM*:

– Activates S.A.F.E.
– Stores fault code 137
– Engine Monitor CHECK ENGINE display: ON

If the both upper and lower micro switches are closed beyond the specified range (5 seconds), the *EMM*:

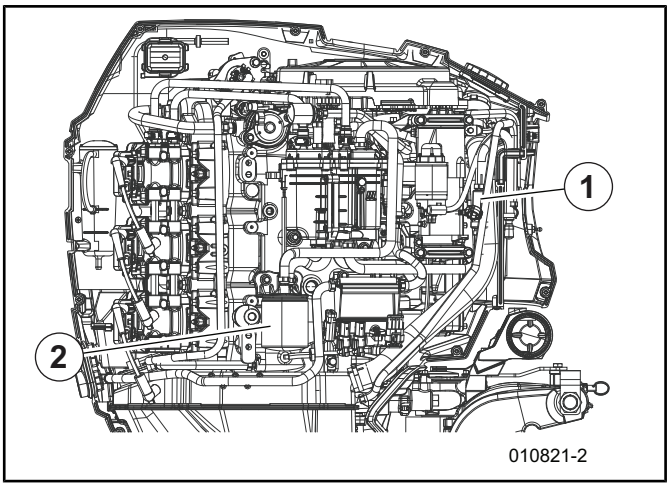
– Activates S.A.F.E.
– Stores fault code 138
– Engine Monitor CHECK ENGINE display: ON

Fuel Filters

Fuel filters protect the fuel lift pump, vapor separator and the high pressure components of the fuel system from contaminants.

A 65 micron inline filter and a 10 micron water separating fuel filter are installed. A water in fuel sensor is mounted in the housing of the water separating fuel filter.

Refer to **Inspection and Maintenance Schedule** for service frequency.



1. Inline fuel filter
2. Water separating fuel filter

Electrical Circuit

The *EMM* monitors the water in fuel electrical circuit. If the circuit is activated, the *EMM*:

– Stores fault code 37
– Engine Monitor CHECK ENGINE display: ON

Fuel Rails

The fuel supply and return rails route fuel through the high pressure side of the fuel system.

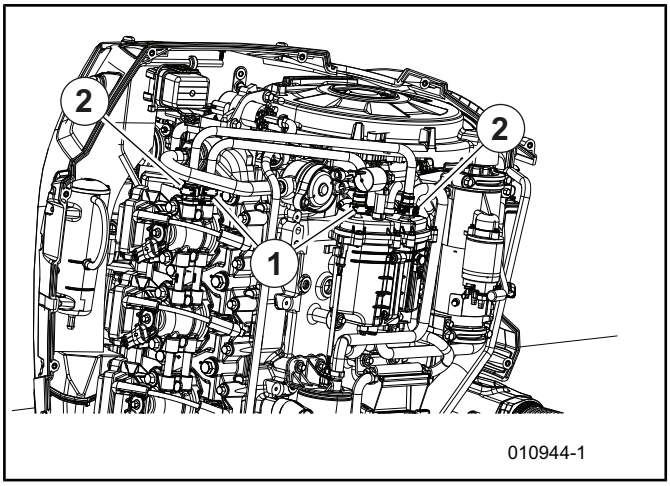
Fuel Supply Rail

The fuel supply rail supplies pressurized fuel to the inlet port of each fuel injector. The fuel supply rails can be identified by the green locking device on each connector fitting.

Fuel Return Rail

The fuel return rail provides a route for fuel passing through the fuel injectors to flow back to the fuel chamber of the fuel pump and vapor separator assembly.

The fuel return rails can be identified by the red locking device on each connector fitting.



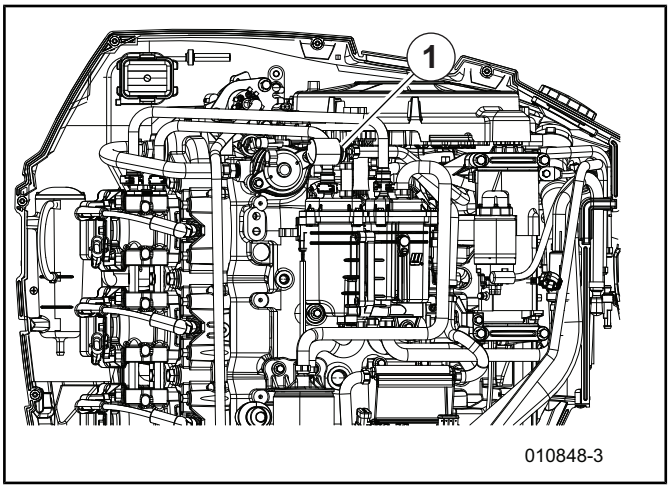
1. Fuel supply rail
2. Fuel return rail

Fuel Reservoir

The vapor separator accumulates fuel in an internal fuel reservoir and supplies fuel to the electric circulation pump. It is water-cooled to enhance vapor separating capabilities.

Fuel Vapor Venting

The fuel vapor vent solenoid regulates fuel level in the reservoir.



1. Vapor vent solenoid

The *EMM* controls fuel vapor vent solenoid operation based on inputs from the fuel level micro switches.

Electrical Circuit

The *EMM* monitors the fuel vapor vent solenoid electrical circuit.

– If the vent solenoid is disconnected (open circuit), the *EMM*:

Stores fault code 159

Engine Monitor CHECK ENGINE display: ON

– If the circuit current is beyond the specified range (short circuit), the *EMM*:

Stores fault code 160

Engine Monitor CHECK ENGINE display: ON

Fuel Circulation Pump

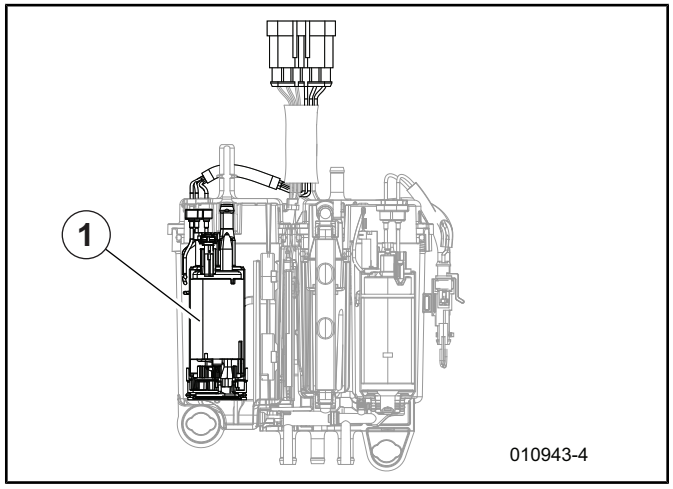
The fuel circulation pump is an electric high pressure fuel pump.

Fuel Supply

The pump is mounted inside the vapor separator and draws fuel from the fuel chamber. It pumps pressurized fuel through a fuel supply rail connected to the fuel injectors.

Electrical Circuit

The circulation pump is controlled by the *EMM* and operates on the 12 V circuit. The circulation pump is activated for 10 seconds when the *EMM* powers up. The fuel circulation pump runs continuously during engine operation.



1. Circulation pump

The *EMM* monitors the fuel circulation pump electrical circuit.

– If the circulation pump is disconnected (open circuit), the *EMM*:

Stores fault code 91

Engine Monitor CHECK ENGINE display: ON

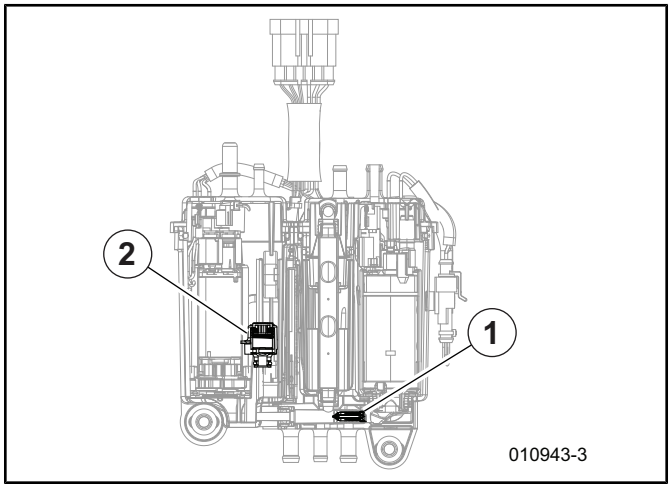
– If the circuit current is beyond the specified range (short circuit), the *EMM*:

Stores fault code 92

Engine Monitor CHECK ENGINE display: ON

Pressure Regulators

Fuel pressure regulators helps maintain consistent fuel pressure in the fuel system. See the **Fuel System Flow Diagram**.



1. *Low pressure regulator*
2. *High Pressure regulator*

Low Pressure Regulator

A low pressure regulator maintains approximately 12 to 17 psi (83 to 117 kPa) of fuel pressure in the low pressure side of the fuel system.

When the fuel pressure in the reservoir exceeds the pressure regulator setting the regulator opens. Fuel then flows through the regulator and an internal passage to the fuel lift pump. Fuel is cycled by the lift pump until pressure is restored to normal levels.

High Pressure Regulator

Fuel returning from the injectors enters the fuel reservoir of the vapor separator through a pressure regulator. The pressure regulator maintains approximately 30 to 42 psi (207 to 289 kPa) of fuel pressure to the fuel injectors in the high pressure side of the fuel system.

Fuel Injectors

Fuel injectors are fuel metering, electric voice coil actuators (55 V) bolted directly to the cylinder head.

Electrical Circuit

The *EMM* controls the activation of each injector by connecting and disconnecting the injector's internal coil to ground.

The *EMM* monitors the fuel injector electrical circuit. If the injector is disconnected (open circuit), the *EMM*:

– Stores fault code 51 – 53 (second digit identifies cylinder)
– Engine Monitor CHECK ENGINE display: ON

Fuel Flow Compensation

The flow rate of each injector is measured as part of the manufacturing process. This information is recorded and assigned to the injector by serial number.

The *EMM* is programmed to compensate for variations in fuel flow. Each injector and its location on the outboard is identified by the *EMM*. DO NOT install an injector without updating the compensation software.

Each service injector includes its fuel flow information. This software allows the *EMM* to be reprogrammed for this injector's unique fuel flow characteristics.

NOTICE

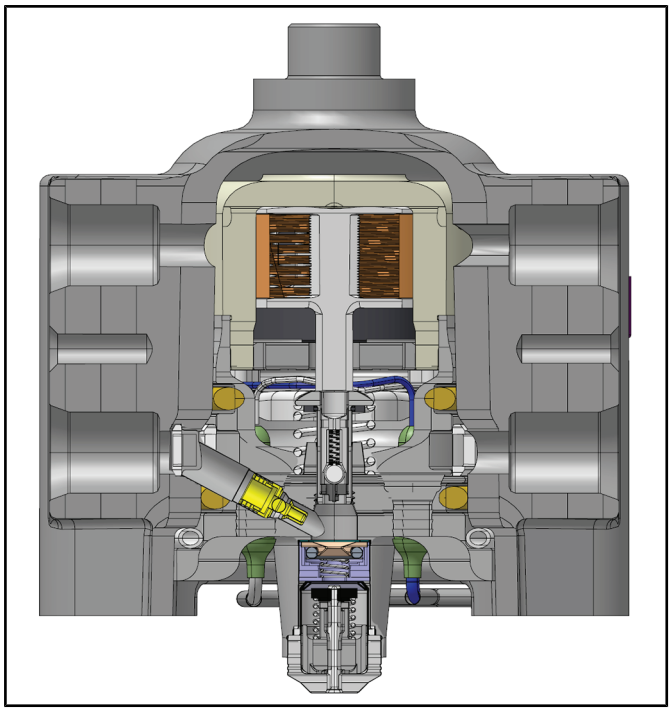
Fuel injectors MUST NOT be moved from one cylinder to another. *EMM* programming is associated with the cylinder location of each injector. Installing an injector on the wrong cylinder can result in powerhead failure.

Injector Fuel Supply

Fuel is supplied to the injectors by the fuel circulation pump and the fuel supply rail.

Each injector has internal fuel passages. These passages are designed to:

– Provide fuel to the injector's injection chamber
– Route fuel through the injector housing to cool the injector coil



Fuel System Priming

⚠ WARNING

Fuel vapors are highly flammable. Perform the following procedure in a well ventilated area. Extinguish all smoking materials and make certain no ignition sources are present. Failure to check for fuel leaks could allow a leak to go undetected, resulting in fire or explosion and may cause personal injury or property damage.

NOTICE

A fuel primer bulb is NOT required and should NOT be installed on *Evinrude E-TEC G2* models.

Evinrude E-TEC G2 models are equipped with an electric fuel lift pump. The electric fuel lift pump runs continuously up to 1 minute when the vapor separator low fuel switch is active.

Make sure the battery is fully charged and reads a minimum of 12 VDC. Turn the Master Power / Key Switch to the ON position to start the fuel priming process.

The high-pressure fuel circuits and injectors will prime as the outboard is cranked with the starter. Observe all fuel lines, both in the boat and on the outboard. Repair any fuel leaks.

Fuel System Tests

SERVICE TOOLS

Description	Part Number	Page
FUEL INJECTOR PULLER KIT	P/N 356461	165
FUEL PRESSURE GAUGE	P/N 5007100	151
FUEL PRESSURE TEST ADAPTER	P/N 353322	151
FUEL PRESSURE TEST ADAPTER	P/N 353332	151
FUEL PRESSURE TEST FITTING KIT	P/N 5010756	149

⚠ WARNING

Use caution when working on any pressurized fuel system. Wear safety glasses and work in a well ventilated area. Extinguish all smoking materials and make certain no open flames or ignition sources exist. Before starting any fuel system service, carefully relieve fuel system pressure. Failure to properly relieve fuel system pressure can result in spraying fuel and/or excessive fuel spilling during servicing. Fuel is flammable and can be explosive under certain conditions.

Fuel System Pressure Tests

⚠ WARNING

Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure.

1. Relieve fuel system pressure. See **Relieving Fuel System Pressure**.
2. Check the *Evinrude Diagnostics* software *Occurred Faults* screen for current fault codes before troubleshooting.
3. Correct any problems and clear the codes FIRST.
4. Inspect all fuel hoses, filters, and connections.
5. Check quality of fuel supply.
6. Use shop towels to clean up any spilled fuel.

ENVIRONMENTAL NOTE

Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

Running Fuel System Tests

Run or crank the outboard.

Use the *Evinrude Diagnostics* software *Monitor* screen to check system voltage. If voltage is low, or drops as RPM increases, refer to **Stator Voltage Output Test**.

Use an inductive timing light to monitor the injector control wire (connector pin 2) for each injector.

Make sure the pickup is attached to only one wire. Flashes on the timing light indicate current in the circuit is being switched by the *EMM*. The *Dynamic Tests* screen allows the control signal to be turned off to a particular injector.

IMPORTANT: Some timing lights may not flash consistently at cranking speeds. Always check the orientation of the timing light pickup and the operation of the timing light.

Results:

No light activation on any injector wires (outboard cranks and starter turns flywheel):

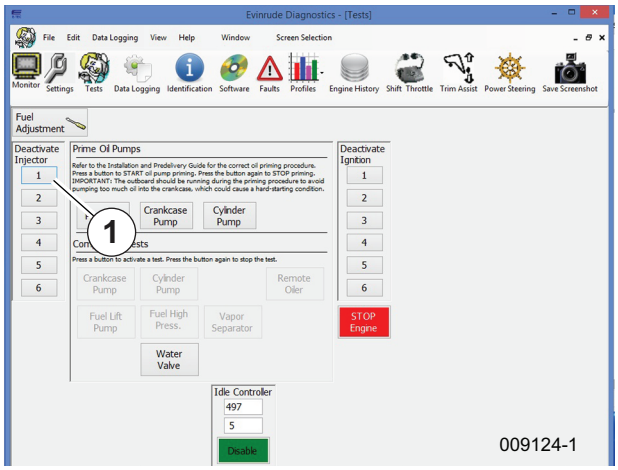
– Check stator input to *EMM*, CPS operation, and all grounds and wiring connections.
– Eliminate all other possibilities to isolate a faulty *EMM*.

Irregular or no light activation on some injector wires:

– Test the resistance of individual injector circuits between the injector connector and injector control wire at the *EMM*.
– Check battery cable connections.
– Make sure all grounds are clean and tight.
– See **Fuel Injector Resistance Test**.

Steady light activation on all injector wires and consistent voltage readings, *EMM* injector control function is good:

– Use the diagnostics software Dynamic Fuel Test to isolate a faulty cylinder. See **Dynamic Tests**.



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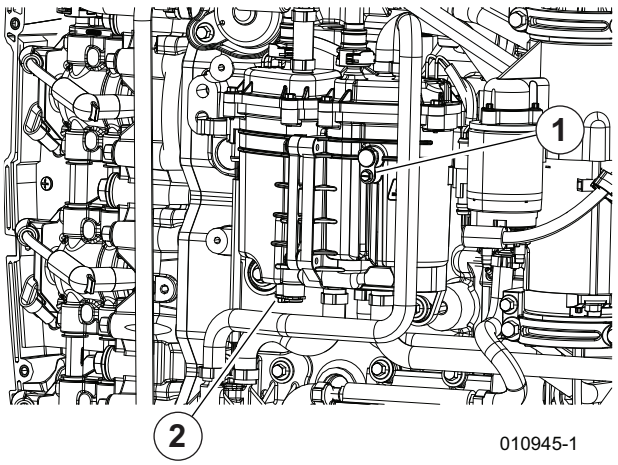
DYNAMIC TESTS SCREEN

1. Deactivate Injector button

Refer to **Fuel System Pressure Tests**.

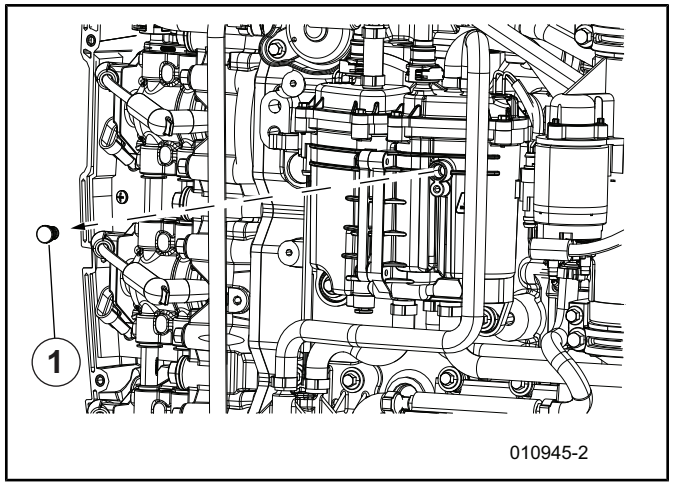
Fuel Pressure Test Fitting Installation

1. Use a 1/4 in. socket or nut driver to remove the screw and retainer from the low pressure plug.
2. Then remove the screw and retainer from the high pressure plug.

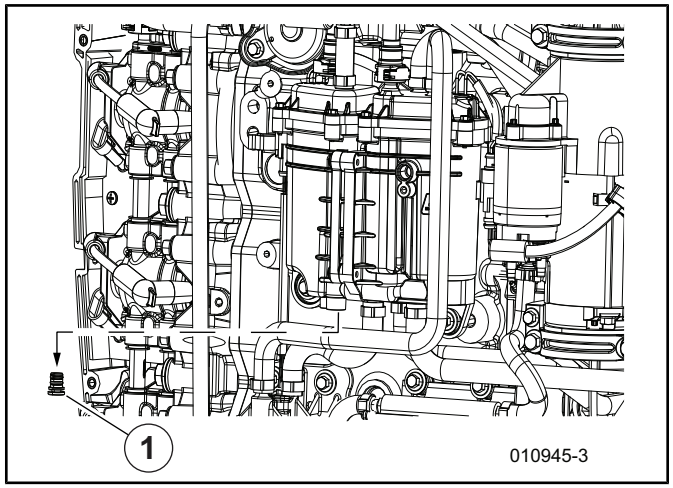


1. Low pressure plug
2. High pressure plug

3. Remove the low pressure plug FIRST. Place shop towels to catch any fuel spillage. Use a pair of needle nose pliers to CAREFULLY remove the plug.
4. Remove the high pressure plug LAST. Use a suitable container to catch fuel from the vapor separator as the plug is removed. Use a pair of needle nose pliers to CAREFULLY remove the plug.



1. Low pressure plug



1. High pressure plug

ENVIRONMENTAL NOTE
Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

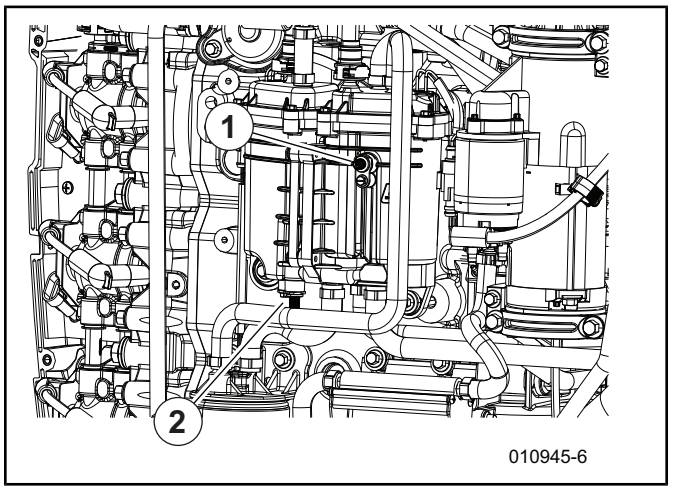
5. Install the fuel pressure test fittings from the Fuel Pressure Test Port Kit, P/N 5010756, into the low and high pressure ports.

Required Tool
Fuel Pressure Test Fitting Kit **P/N 5010756**

6. Install a retainer with a screw on each fitting.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the vapor separator assembly.

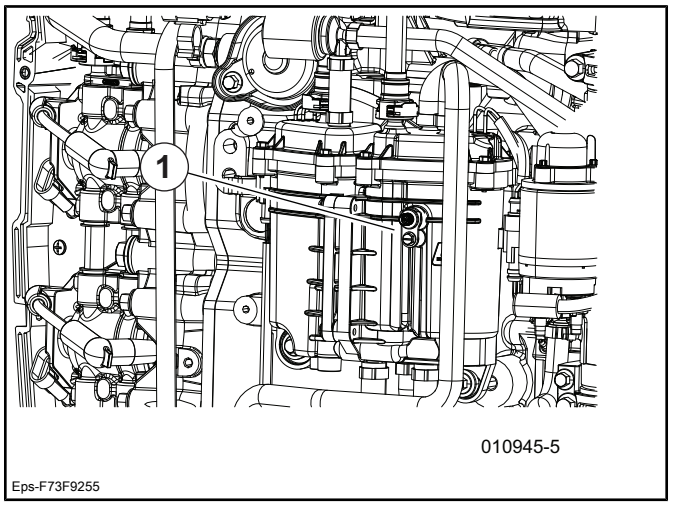
7. Tighten the screws to a torque of 25 to 35 in. lbs. (2.9 to 3.9 N.m).



1. Low pressure test fitting
2. High pressure test fitting

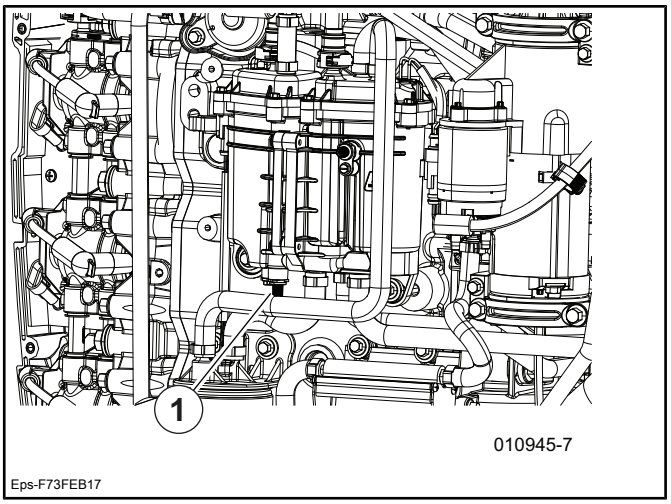
Fuel Pressure Test Fitting Removal

1. Use a 1/4 in. socket or nut driver to remove the screw and retainer from the low pressure test fitting. Place shop towels to catch any fuel spillage. CAREFULLY remove the fitting.



1. Low pressure test fittting

2. Remove the screw and retainer from the high pressure test fitting. Use a suitable container to catch fuel from the vapor separator as the fitting is removed. Use a pair of needle nose pliers to CAREFULLY remove the fitting.



1. High pressure test fittting

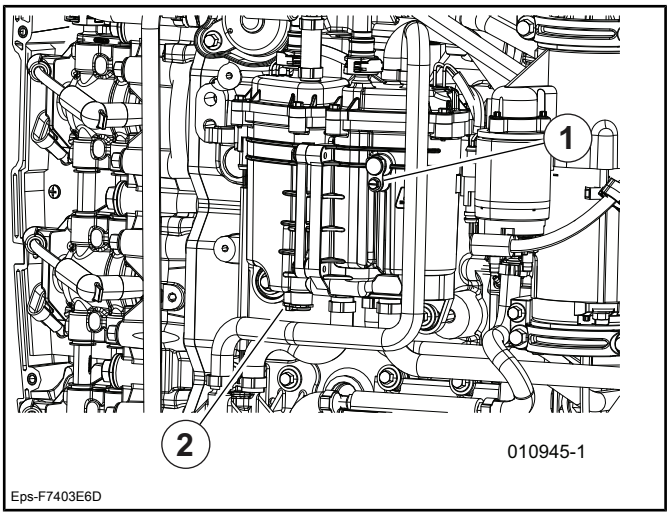
Use shop towels to clean up any spilled fuel.

ENVIRONMENTAL NOTE
Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

3. Install the plugs into the low and high pressure ports. Install a retainer with a screw on each plug.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the vapor separator assembly.

4. Tighten the screws to a torque of 25 to 35 in. lbs. (2.9 to 3.9 N.m).



1. Screw (low pressure test fitting)
2. Screw (high pressure test fitting)

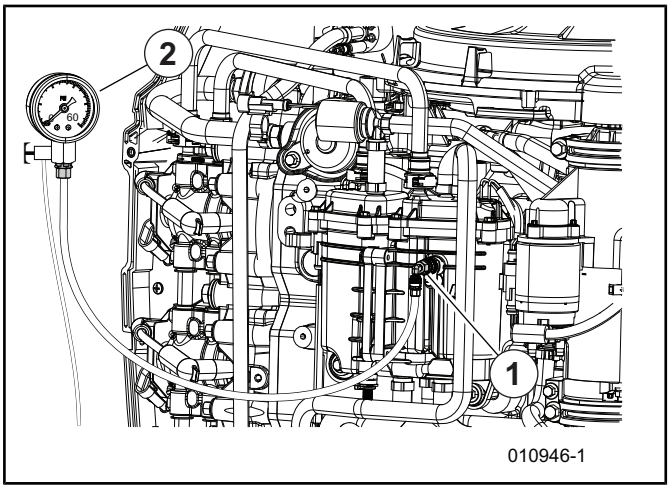
Electric Fuel Pump Pressure Test

1. Install Fuel Pressure Test Adapter, P/N 353322, on the low pressure test fitting on the vapor separator assembly.

Required Tools
Fuel Pressure Gauge **P/N 5007100**
Fuel Pressure Test Adapter **P/N 353332**

2. Install a 0 to 60 psi (0 to 415 kPa) Fuel Pressure Gauge, P/N 5007100 or equivalent, onto the adapter.

If the outboard is run above idle speed, expect fuel pressure to range from 7 to 17 psi (48 to 117 kPa). Be sure to use a fuel pressure gauge with a range that exceeds 17 psi (117 kPa).



1. Fuel Pressure Test Adapter, P/N 353322
2. Fuel Pressure Gauge, P/N 5007100 (or equivalent)

3. Prime the fuel system and check for leaks.
4. START the outboard and run at idle speed.
5. Monitor the gauge for pressure reading.
6. Pressure should stabilize and gauge must not indicate less than 6 psi (41 kPa).

Results:

Normal pressure

– Perform the **Fuel Lift Pump Vacuum Test**. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.

Low pressure

– Perform the **Fuel Lift Pump Vacuum Test**. Make sure no air leaks or restrictions exist in the fuel supply hose or boat fuel system.
– Check fuel flow through fuel lift pump.

Relieve fuel system pressure before removing fuel pressure gauge. Refer to

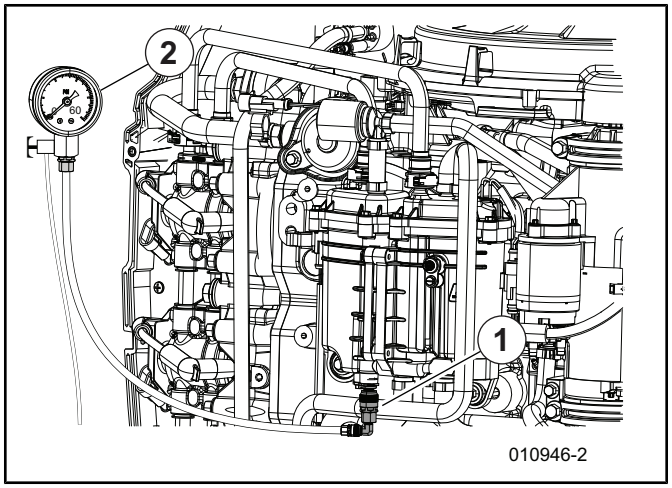
Use shop towels to clean up any spilled fuel.

Fuel Circulation Pump Pressure Test

1. Install Fuel Pressure Test Adapter, P/N 353322, on the high pressure test fitting on the vapor separator assembly.

Required Tools
Fuel Pressure Test Adapter **P/N 353322**
Fuel Pressure Gauge **P/N 5007100**

2. Install a 0 to 60 psi (0 to 415 kPa) Fuel Pressure Gauge, P/N 5007100 or equivalent, onto the adapter.



1. Fuel Pressure Test Adapter, P/N 353322
2. Fuel Pressure Gauge, P/N 5007100 (or equivalent)

Running Outboard

1. START the outboard and check pressure.

NOTE: System pressure should be 36 to 42 psi (248 to 289 kPa) @ idle RPM.

2. Shut OFF outboard and monitor pressure gauge.

Non-Running Outboard

1. If the outboard does not run, turn the key switch to the ON position to prime the fuel system.
2. Crank the outboard.
3. Check the circulation pump operation.
4. Check fuel system pressure.

Results:

Normal pressure

– Observe pressure reading after outboard is shut OFF. Pressure should not drop below 20 psi (138 kPa).

Pressure continues to drop below 20 psi (138 kPa) after outboard is shut OFF:

– Check for leaking fuel injector.
– Check for leaking pressure regulator.
– Check for external fuel system leak.

High pressure:

– Check for restricted filter in fuel return fitting of vapor separator, damaged pressure regulator in vapor separator, or restricted fuel return rail.

Low pressure

– Check fuel supply to fuel lift pump. Refer to **Fuel Lift Pump Vacuum Test.** Higher vacuum readings indicate restrictions in the fuel supply. Repair or replace as needed.
– Restricted inline fuel filter.
– Restricted fuel filter/water separator assembly.
– If the above tests are good and vapor separator remains full of fuel, check for damaged circulation pump. Replace vapor separator assembly.

No pressure

– Check electrical circuit and ground connections for circulation pump
– If voltage is present and pump does not run, repair connection or replace vapor separator assembly.

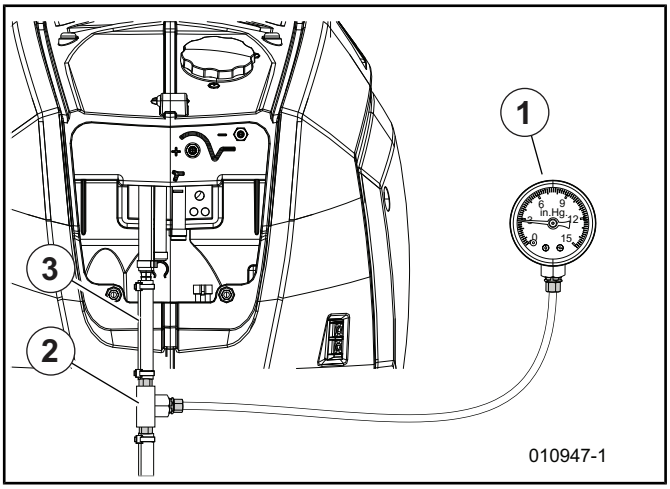
Relieve fuel system pressure before removing fuel pressure gauge. Refer to **Relieving Fuel System Pressure**.

Fuel Lift Pump Vacuum Test

1. Confirm fuel supply to the fuel lift pump.
2. Temporarily install a vacuum gauge, T-fitting, and 8 in. (20.3 cm) of clear vinyl hose between the fuel supply hose and fuel lift pump (inlet).
3. Secure connections to prevent fuel or air leaks.

NOTICE

Do not use fuel primer bulb, manual fuel primer, or electric fuel pump primer to restart outboard. A positive pressure in the fuel supply could damage some vacuum gauges.



1. Vacuum gauge
2. T-fitting
3. Clear hose

4. START outboard and run at FULL THROTTLE for at least two minutes.
5. Monitor clear vinyl hose for the presence of air.

NOTE: Air bubbles indicate a faulty hose, connection, or fuel tank pick-up.

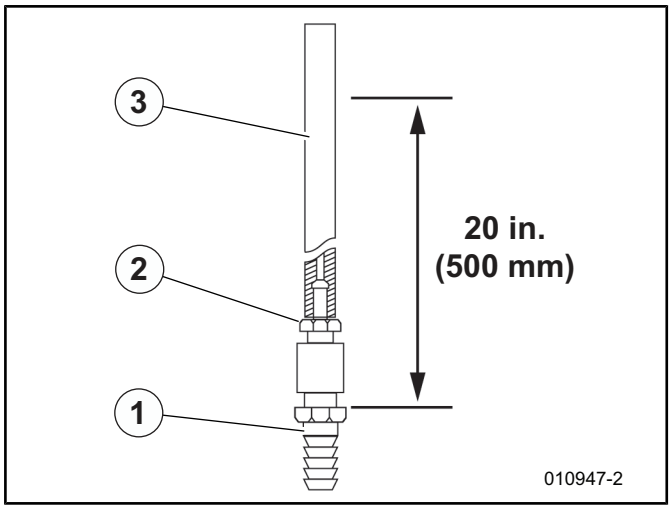
6. Repair, if necessary, before proceeding.

NOTE: There should be no air or vapor bubbles visible in the clear hose. The maximum inlet fuel vacuum should not exceed 4 in. Hg. (13.5 kPa) at the inlet to the fuel lift pump under any operating conditions (IDLE to WOT).

A higher vacuum indicates an excessive restriction in the fuel supply. Repair as needed. Refer to **Fuel System Requirements** for fuel supply component requirements.

Anti-Siphon Valve Test

1. Remove anti-siphon valve from fuel tank.
2. Install adapter fittings and a 36 in. (91.4 cm) length of clear hose to the inlet side (tank end) of valve.



1. *Anti-siphon valve*
2. *Adapter fitting*
3. *Clear hose*

3. Fill clear hose with water to a height of 20 inches (500 mm).

NOTE: Water must NOT flow through valve. An occasional drip is acceptable. Replace valve if water drips continuously.

4. Increase height of water to 25 inches (630 mm).
5. Water should flow through valve as water level reaches 25 inches (630 mm).
6. Replace the anti-siphon valve if test results are different.

Fuel System Electrical Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Leads from the test probe kit can be repaired, or custom test leads can be made locally if needed. Refer to **Electrical Testing**.

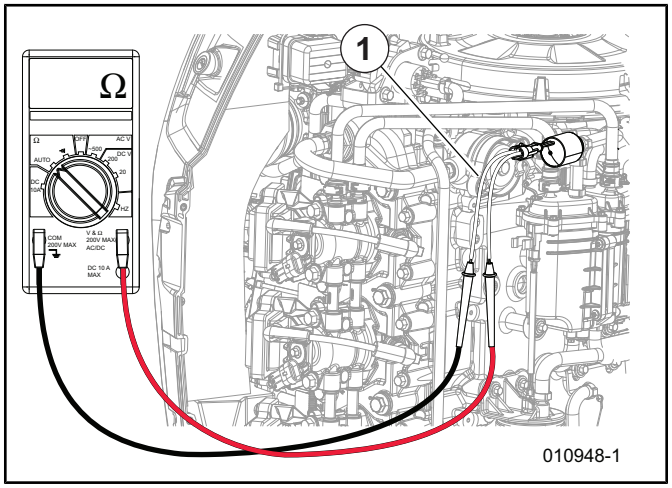
Fuel system electrical circuits are dependent on wiring and connections, *EMM* supplied current and component resistance. The supplied current flows through the wiring circuit and component before returning to the *EMM*.

Circuit tests check the integrity of the main engine harness and *EMM* circuits using a diode test. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

Vapor Vent Solenoid Resistance Test

1. Disconnect the battery cables at the battery.
2. Remove the electrical connector from the vapor vent solenoid.
3. Use a digital multimeter with appropriate test probe leads or adapters to measure the solenoid coil resistance.

Vapor Vent Solenoid Coil Resistance
17–23 Ω @ 72°F (22°C)



1. *Test probe leads / adapters*

Vapor Vent Solenoid Circuit Test

1. Remove the electrical connector from the vapor vent solenoid.
2. Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.
3. Connect the negative meter lead to the wire listed in the table.
4. Connect the positive meter lead to engine ground.

Vapor Vent Solenoid Circuit Diode Test		
Wire	**Pin**	**Result**
BROWN/ YELLOW	1	approximately 0.5 VDC

Results:

– No reading (OL or ∞) indicates an open circuit.
– A reading of zero (0) indicates a short circuit.

7

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the vapor vent solenoid ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Vapor Vent Solenoid Ground Circuit Resistance		
Wire	**Pin**	**Result**
BLACK	2	< 1 Ω

Results:

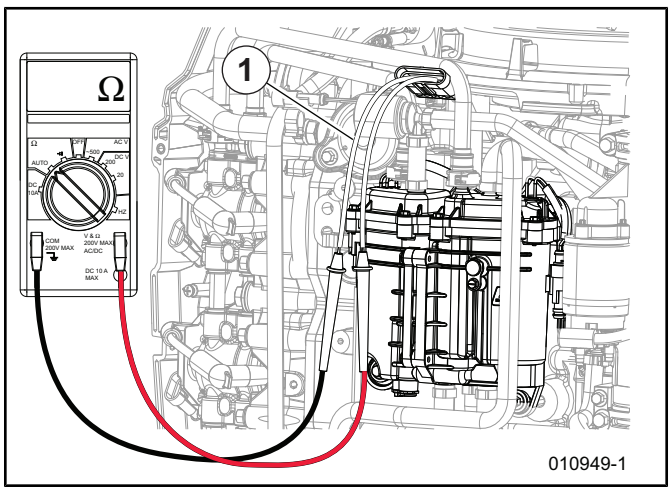
– An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Electric Fuel Lift Pump Resistance Test

1. Disconnect the battery cables at the battery.
2. Remove the electrical connector from the fuel pump and vapor separator assembly.
3. Use a digital multimeter with appropriate test probe leads to measure the fuel pump coil resistance.
4. Connect the black meter lead to the black wire, connect the red meter lead to the red wire.

Fuel Pump Resistance Test
< 10 Ω @ 77°F (25°C)



1. Appropriate test probe leads

Electric Fuel Pump Circuit Test

1. Remove the electrical connector from the fuel pump and vapor separator assembly.
2. Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.
3. Connect the negative meter lead to the wire listed in the table.
4. Connect the positive meter lead to engine ground.

Fuel Pump Circuit Diode Test		
Wire	**Pin**	**Result**
BROWN/ WHITE	3	approximately 0.5 VDC

Results:

– No reading (OL or ∞) indicates an open circuit.
– A reading of zero (0) indicates a short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

5. Use a digital multimeter to measure the resistance of the fuel pump and vapor separator assembly electrical connector and engine ground.

Fuel Pump Ground Circuit Resistance		
Wire	**Pin**	**Result**
BLACK	2	< 1 Ω

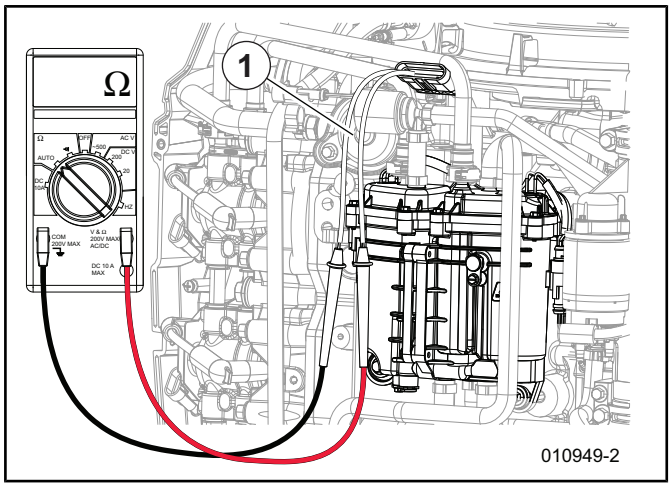
Results:

An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Circulation Pump Resistance Test

1. Disconnect the battery cables at the battery.
2. Remove the electrical connector from the fuel pump and vapor separator assembly.
3. Use a digital multimeter with appropriate test probe leads to measure the fuel pump coil resistance.
4. Connect the black meter lead to the black wire, connect the red meter lead to the blue wire.

Fuel Circulation Pump Resistance
< 10 Ω @ 77°F (25°C)



1. Appropriate test probe leads

Fuel Circulation Pump Circuit Test

1. Remove the electrical connector from the fuel pump and vapor separator assembly.
2. Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.
3. Connect the negative meter lead to the wire listed in the table.
4. Connect the positive meter lead to engine ground.

Fuel Circulation Pump Circuit Diode Test		
Wire	**Pin**	**Result**
BROWN	1	approximately 0.5 VDC

Results:

– No reading (OL or ∞) indicates an open circuit.
– A reading of zero (0) indicates an short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the fuel pump and vapor separator ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Fuel Circulation Pump Ground Circuit Resistance Test		
Wire	**Pin**	**Result**
BLACK	2	< 1 Ω

Results: An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Level Switch Circuit Test

1. Remove the electrical connector from the fuel pump and vapor separator assembly.
2. Use the diode test function of a digital multimeter with appropriate test probe leads to check the sig-nal circuit.
3. Connect the negative meter lead to the wire listed in the table.
4. Connect the positive meter lead to engine ground.

Fuel Level Switch Circuit Diode Test		
Wire	**Pin**	**Result**
BROWN/ GREEN	6	1.5–3.0 VDC
BROWN/ ORANGE	5	

Results:

– No reading (OL or ∞) indicates an open circuit.
– A reading of zero (0) indicates a short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the fuel level switch ground circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Fuel Level Switch Ground Circuit Resistance		
Wire	**Pin**	**Result**
Black	4	< 1 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

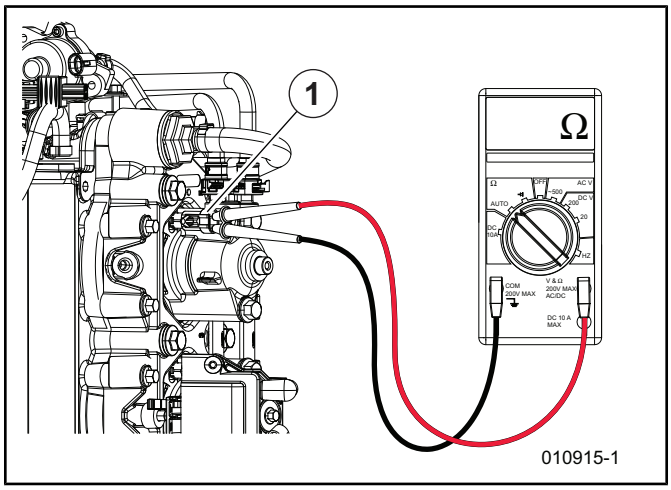
Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Injector Resistance Test

1. Disconnect the battery cables at the battery.

2. Remove the electrical connector from the fuel injector.
3. Use a digital multimeter with appropriate test probe leads to measure the injector coil resistance.

Fuel Injector Coil Resistance
2–3 Ω @ 72° (22°C)



1. Fuel injector electrical connector

Fuel Injector Circuit Test

1. Remove the electrical connector from the fuel injector.
2. Use the diode test function of a digital multimeter with appropriate test probe leads to check the signal circuit.
3. Connect the negative meter lead to the wire listed in the table.
4. Connect the positive meter lead to engine ground.

Fuel Injector Signal Circuit Diode Test		
Wire	**Pin**	**Result**
BLUE	2	approximately 0.5 VDC
PURPLE	2	
GREEN	2	

Results:

– No reading (OL or ∞) indicates an open circuit.
– A reading of zero (0) indicates a short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Use a digital multimeter with appropriate test probe leads to measure the resistance of the fuel injector 55V circuit.

Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to the red/white wire of a known good circuit such as an oil pump.

Fuel Injector 55V Circuit Resistance		
Wire	**Pin**	**Result**
WHITE/RED	1	< 1 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Fuel Component Servicing

SERVICE TOOLS

Description	Part Number	Page
FUEL INJECTOR PULLER KIT	P/N 356461	165
FUEL PRESSURE GAUGE	P/N 5007100	151
FUEL PRESSURE TEST ADAPTER	P/N 353322	151
FUEL PRESSURE TEST ADAPTER	P/N 353332	151
FUEL PRESSURE TEST FITTING KIT	P/N 5010756	149

SERVICE PRODUCTS

Description	Part Number	Page
NUT LOCK	P/N 500418	171

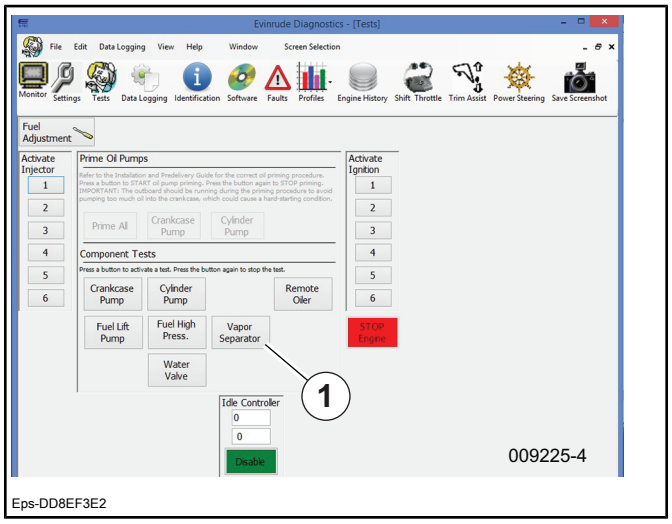
⚠ WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Use caution when working on any part of the fuel system.
Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure.
Always disconnect the battery cables at the battery before servicing the fuel system unless instructed to do otherwise.
Always work in a well ventilated area and wipe off any spilled fuel.
DO NOT smoke and make certain no open flames or ignition sources exist.
After servicing the fuel system check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

Relieving Fuel System Pressure

IMPORTANT: Minimize fuel system pressure prior to disassembly.

1. Remove the propeller from the outboard.
2. Disconnect the electrical connector of the fuel pump and vapor separator assembly.
3. Start and run the outboard at IDLE for several seconds and STOP the outboard.
4. If the outboard does NOT run, crank for 10 seconds.
5. Disconnect the battery cables at the battery.
6. Use the *Tests* screen of *Evinrude Diagnostic* software v 6.1 or higher.
7. Select the Vapor Separator button to activate the fuel vapor vent solenoid.



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1. Vapor Separator button

Fuel Filter Service

1. Disconnect the battery cables at the battery.
2. Remove fuel filters carefully to prevent spilling the filter's contents.
3. Use shop towels to clean up any spilled fuel.

ENVIRONMENTAL NOTE

Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

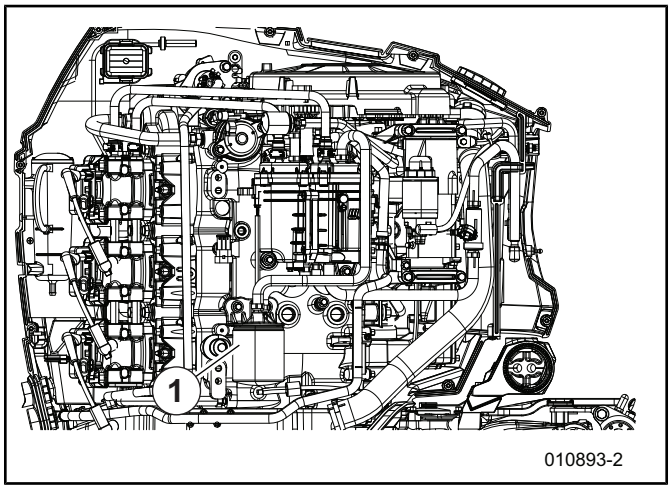
Inspect fuel filter contents for any presence of water. If water is present, identify the source and correct the problem. If necessary, take additional fuel samples and drain fuel tank(s).

Water Separating Fuel Filter

IMPORTANT: Replace the water separating fuel filter when replacing a vapor separator.

Removal

1. Place shop towels to catch any fuel spillage.



1. Water separating fuel filter

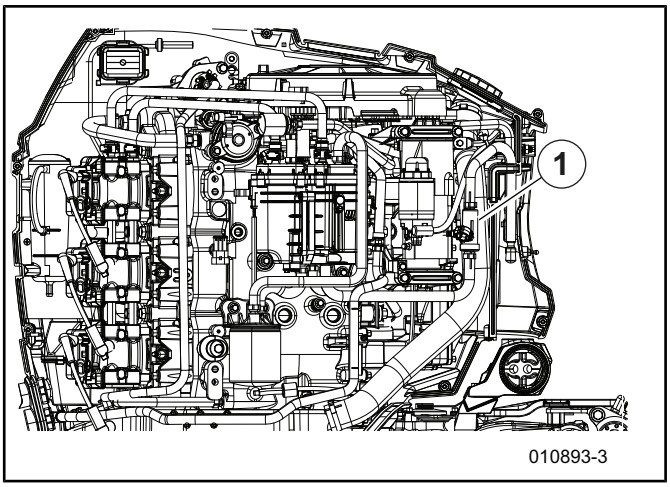
2. Use an appropriate filter wrench to turn the filter in a counterclockwise direction.
3. Remove the filter carefully to prevent spilling the filter's contents.

Installation

1. Lubricate filter seal with outboard lubricant and position filter on threaded mounting tube of filter bracket.
2. Take care not to damage water in fuel sensor probe.
3. Hand tighten until seal contacts filter housing.
4. Tighten an additional two—thirds of a turn.
5. Connect the battery cables at the battery.
6. Run the outboard and check for fuel leaks.

Inline Fuel Filter Removal

Remove the *Oetiker* clamps from the fuel supply hoses. Then remove the filter.



1. Inline filter

Inline Fuel Filter Installation

1. Install new *Oetiker* clamps over the fuel supply hoses. The install the new filter into the fuel supply hoses.

NOTE: Note arrow indicating direction of fuel flow on filter.

2. Use *Oetiker* pincer pliers, P/N 350860, to secure the *Oetiker* clamps.
3. Connect the battery cables at the battery.
4. Run the outboard and check for fuel leaks.

Vapor Separator Service

IMPORTANT: Replace the water separating fuel filter when replacing a vapor separator.

Removal

⚠ WARNING

When servicing the fuel system, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure**.

Use the following instructions to remove the vapor separator and hoses as an assembly to avoid damaging the hose fittings of the vapor separator.

Disconnect the battery cables at the battery.

Remove the engine top and rear covers. Remove the starboard frame. Refer to **Engine Cover and Frame Service**.

Disconnect vapor separator electrical connector.

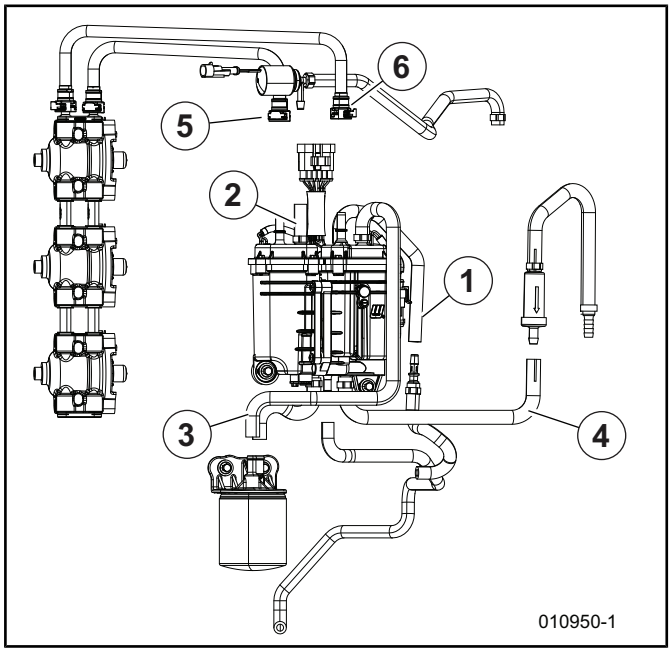
Place shop towels to catch any spilled fuel. Use an appropriate container to catch fuel when removing fuel filter and fuel inlet hoses. Fuel hoses may contain up to 3 to 4 ounces (88 to 118 ml) of fuel.

Carefully remove the *Oetiker* clamps from the:

1. Connector to upper cooling water hose
2. Vapor vent solenoid inlet hose
3. Fuel filter housing hoses
4. Fuel outlet hose at the inline fuel filter

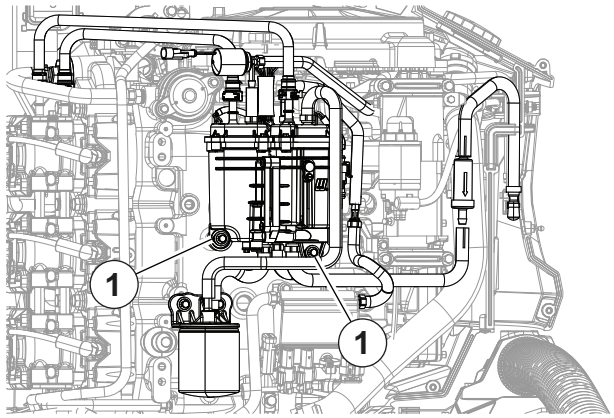
Then disconnect the:

1. Fuel supply rail
2. Fuel return rail
   Refer to **Quick Connector Locking Fittings**.



1. Upper cooling water hose
2. Vapor vent solenoid inlet hose
3. Fuel filter housing hoses
4. Fuel outlet hose
5. Fuel supply rail
6. Fuel return rail

1. Remove the two lower vapor separator mounting screws and washers.
2. Remove the vapor separator and remaining hoses as an assembly.
3. Carefully remove the *Oetiker* clamp from lower cooling water hose after the vapor separator is removed from the engine.
4. Then remove the lower cooling water hose from the vapor separator.



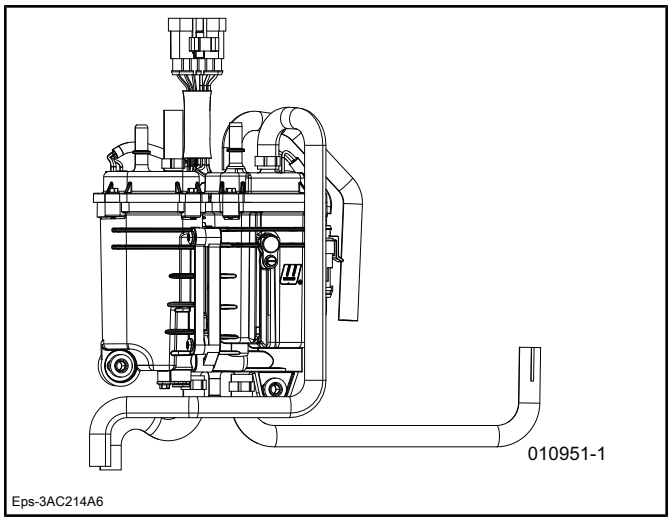
1. Lower vapor separator mounting screws and washers

5. Place the assembly in a large tray or other suitable container to catch the fuel from the vapor separator.

NOTE: A full assembly can hold over 32 oz.(1 L) of fuel.

ENVIRONMENTAL NOTE
Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

6. Take the assembly to a work bench or other suitable work surface.
7. Carefully remove the *Oetiker* clamps from the remaining hoses and then remove the hoses from the vapor separator..



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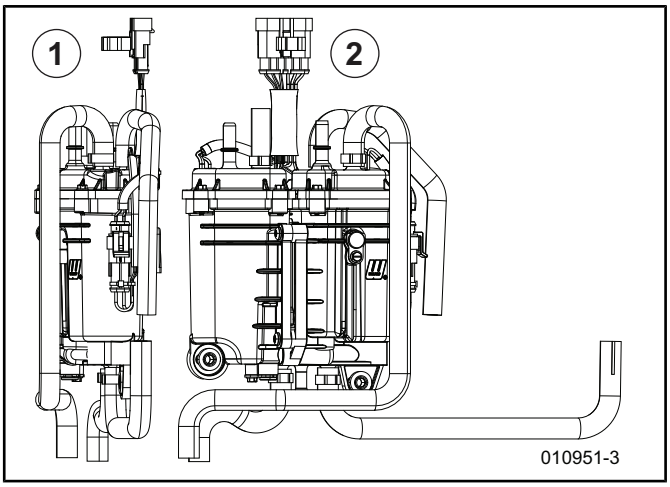


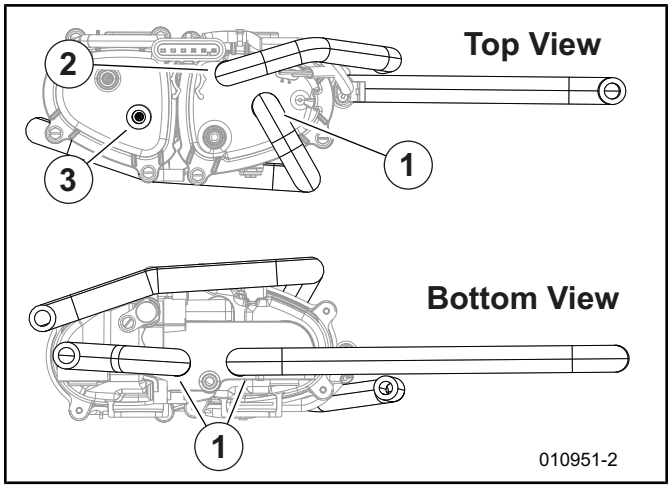
1. Forward view
2. Starboard view

Installation

⚠ WARNING

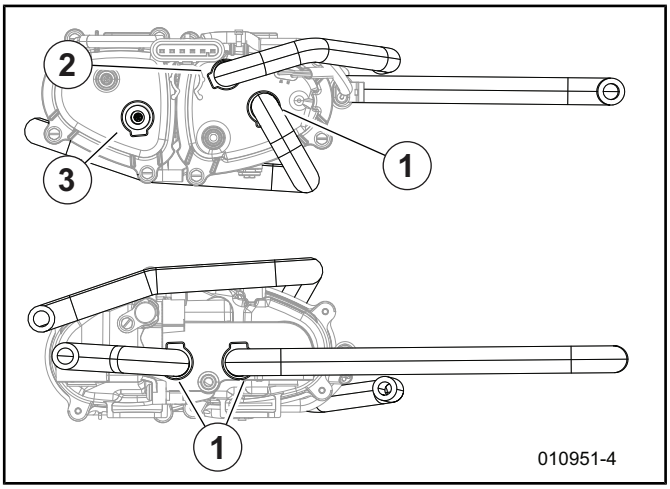
After servicing the fuel system check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

1. Do **NOT** secure *Oetiker* clamps until step 5.
2. Install and orient fuel hoses as shown below. Use new 17.0 mm *Oetiker* clamps.
3. Install and orient upper cooling water hose as shown below. Use new 15.7 mm *Oetiker* clamp.
4. Install vapor vent solenoid hose. Use new 15.7 mm *Oetiker* clamp.



HOSE ORIENTATION
1. Fuel hoses
2. Upper cooling water hose
3. Vapor vent solenoid hose

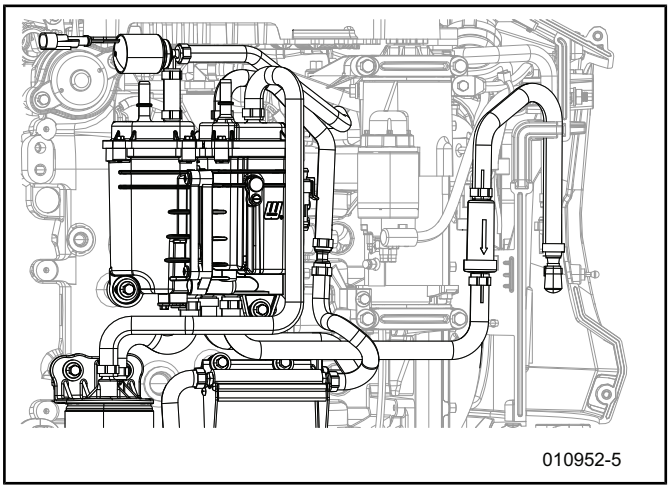
5. Orient the ear of each *Oetiker* clamp as shown. Then use *Oetiker* pincer pliers to secure the clamps.



1. 17.0 mm Oetiker clamps
2. 15.7 mm Oetiker clamp
3. 15.7 mm Oetiker clamp

6. Take the vapor separator assembly to the outboard.
7. Install the cooling water hose on the lower vapor separator cooling water fitting with a new 15.7 mm *Oetiker* clamp. Orient the ear of the clamp toward the block and secure the clamp.
8. Apply soapy water to the mounting grommets for the vapor separator. Install the vapor separator on the engine.
9. Install the washers and screws. Tighten screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
10. Install the upper cooling water hose to the connector with a new 15.7 mm *Oetiker* clamp. Orient the ear of the clamp towards STARBOARD and secure the clamp.
11. Install the vapor separator solenoid onto the vent outlet hose with a new 15.7 mm *Oetiker*

clamp. Orient the ear of the clamp towards STARBOARD and secure the clamp.
12. Install the fuel inlet hose onto the inline fuel filter with a new 17.0 mm *Oetiker* clamp. Orient the ear of the clamp towards FORWARD and secure the clamp.
13. Install the fuel hoses onto the fittings of the water separating fuel filter housing with new 17.0 mm *Oetiker* clamps. Orient the ear of the clamps toward STARBOARD/FORWARD and secure the clamps.



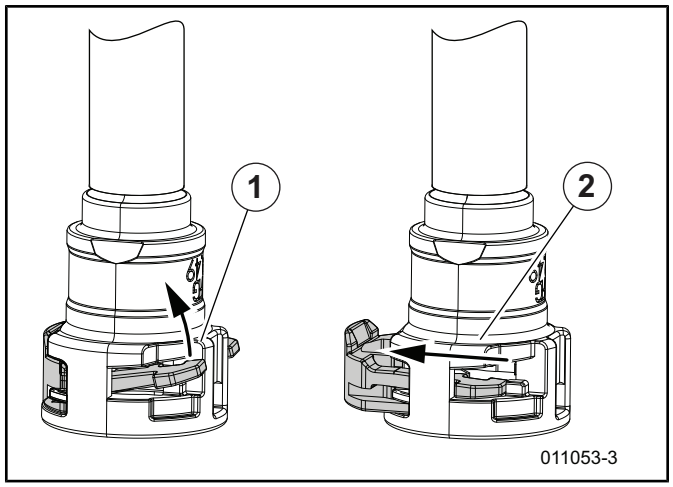
HOSE CLAMP ORIENTATION

14. Connect the fuel rails to the vapor separator. Refer to **Quick Connector Locking Fittings**.
15. Connect the electrical connector to the vapor separator.
16. Connect battery cables at the battery.
17. Prime the fuel system and check for fuel leaks. Repair all leaks.
18. Supply water to the engine. Start and run the out-board and check for fuel leaks. Repair all leaks before returning the outboard to service.
19. Install starboard frame. Install the rear and top covers. Refer to **Engine Cover and Frame Service**.

Fuel Rail Service

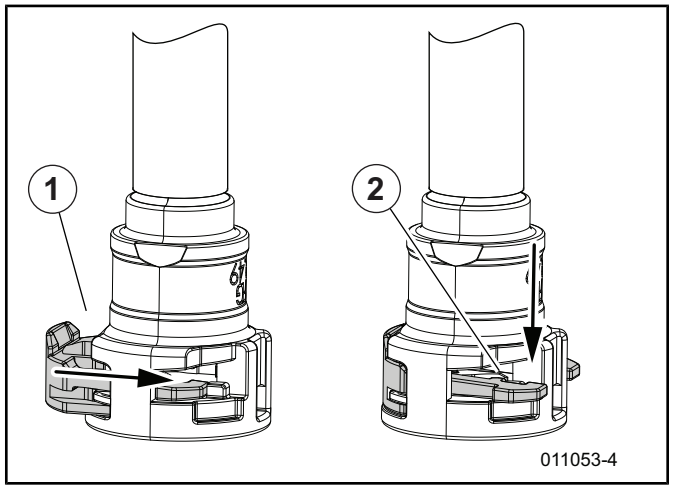
Quick Connector Locking Fittings

The fuel rails are equipped with quick connector locking fittings. Lift the two tabs of the locking device and push to unlock the quick connector fittings.



1. *Lift tabs*
2. *Push tabs to unlock*

Push the locking device to lock the quick connector fittings. Make sure tabs are in the locked position.



1. *Push locking device*
2. *Tab in locked position*

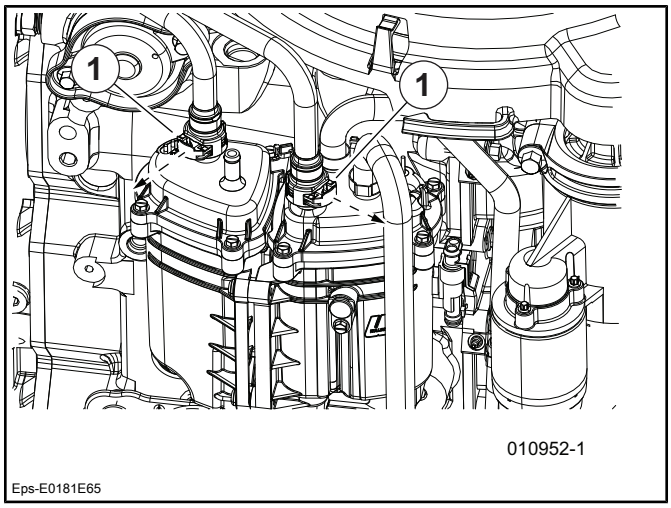
Removal

1. Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure**.

⚠ WARNING

When servicing the fuel system, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

2. Disconnect the battery cables at the battery.
3. Remove the engine top and rear covers.
4. Remove the starboard frame.
5. Unlock and remove the quick connectors from the fuel pump and vapor separator assembly.
6. Use shop towels to wipe up any spilled fuel.



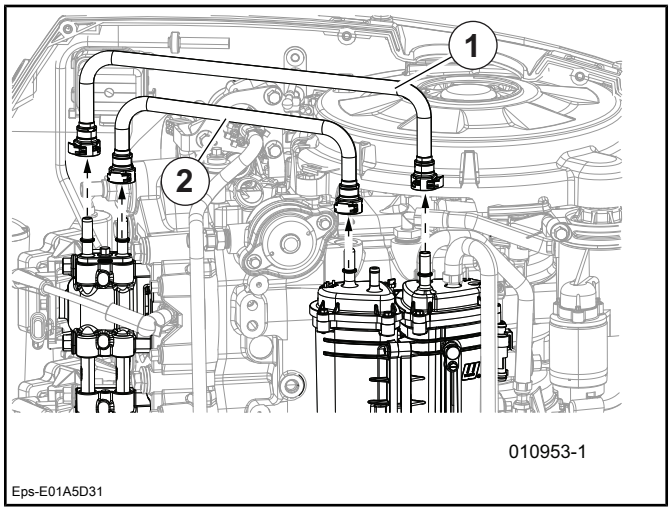
1. Fuel rail quick connectors

7. Unlock the quick connectors from the fuel injectors.
8. Remove the quick connectors from the fuel injectors.
9. Use shop towels to wipe up any spilled fuel, then remove the connectors from the fuel injectors.

ENVIRONMENTAL NOTE

Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

10. Remove the fuel rails from the engine.



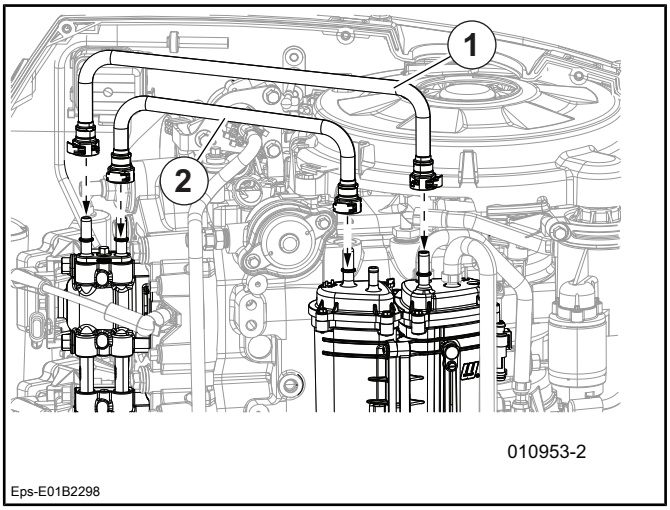
1. Fuel return rail
2. Fuel supply rail

Installation

⚠ WARNING

After servicing the fuel system check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

1. Check condition of the sealing O-rings on fuel rail fittings. Lubricate O-rings with outboard lubricant.
2. Position the fuel rails on the engine.



1. Fuel return rail
2. Fuel supply rail

3. Install the fuel rail fittings onto the fuel fittings of the upper fuel injector.

NOTE: The fuel supply rail uses green locking devices. Position the fuel supply rail on the fitting closest to the cylinder head.

The fuel return rail uses a red locking device. Position the fuel return rail on the fitting farthest from the cylinder head.

4. Install the fuel rail fittings on to the fuel fittings of the fuel pump and vapor separator assembly.

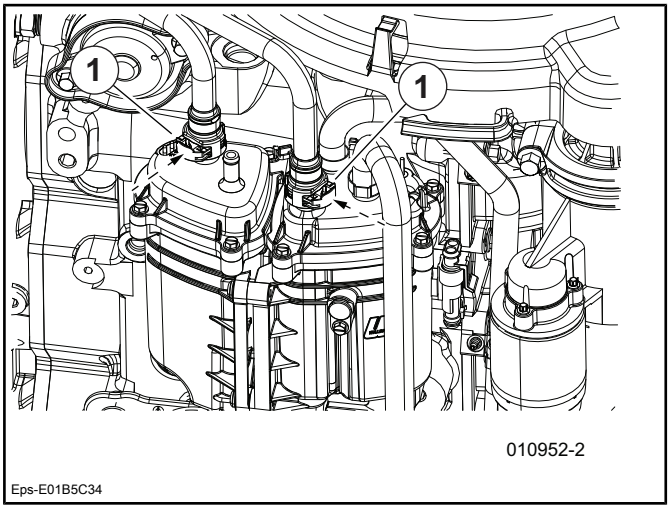
NOTE: The fuel supply rail uses green locking devices. Position the fuel supply rail on the fitting closest to the cylinder head.

The fuel return rail uses a red locking device. Position the fuel return rail on the fitting farthest from the cylinder head.

5. Push the locking device to lock the quick connector fittings.

NOTE: Make sure fittings are fully seated.

Make sure tabs are in the locked position.



1. Fuel rail quick connectors

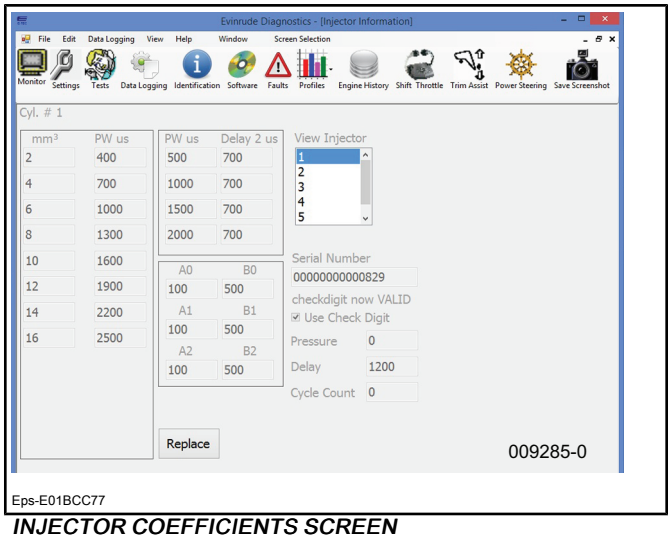
6. Connect the battery cables at the battery.
7. Prime the fuel system and check for fuel leaks. Repair all leaks.
8. Supply water to the engine. Start and run the outboard and check for fuel leaks. Repair all leaks before returning the outboard to service.
9. Install the starboard frame.
10. Install the engine rear and top covers. Refer to **Engine Cover and Frame Service**.

Fuel Injector Service

Mark fuel injectors to show cylinder locations.

NOTICE

Fuel injectors must be installed in the correct cylinder locations. Use *Evinrude Diagnostics* software to make sure that *EMM* programming matches injector positioning. The Injector Coefficients screen displays injector serial numbers.



INJECTOR COEFFICIENTS SCREEN

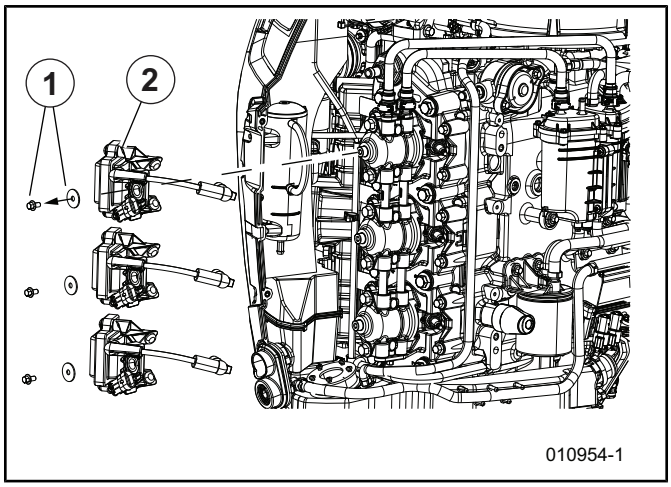
Use caution when handling fuel injectors. Prevent dirt and debris from entering fuel inlet and outlet ports of injectors or fuel rails. Cover the injector nozzle port in cylinder head to prevent contamination of combustion chamber.

Removal

⚠ WARNING

When servicing the fuel system, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

1. Relieve fuel system pressure. Refer to **Relieving Fuel System Pressure**.
2. Disconnect the battery cables at the battery.
3. Remove the engine top and rear covers.
4. Remove the starboard frame.
5. Disconnect the electrical connectors from each ignition coil.
6. Remove the ignition coil bracket retaining screws and washers. Then remove the ignition coil and bracket assemblies from the engine.



1. Screws and washers
2. Ignitioin coil and bracket assemblies

7. Disconnect the electrical connector from each fuel injector.
8. Remove fuel rails from the bank of fuel injectors. Refer to **Fuel Rail Service**.
9. Use shop towels to catch any spilled fuel.

ENVIRONMENTAL NOTE
Dispose of fuel and fuel contaminated towels in an environmentally responsible manner or according to local regulations.

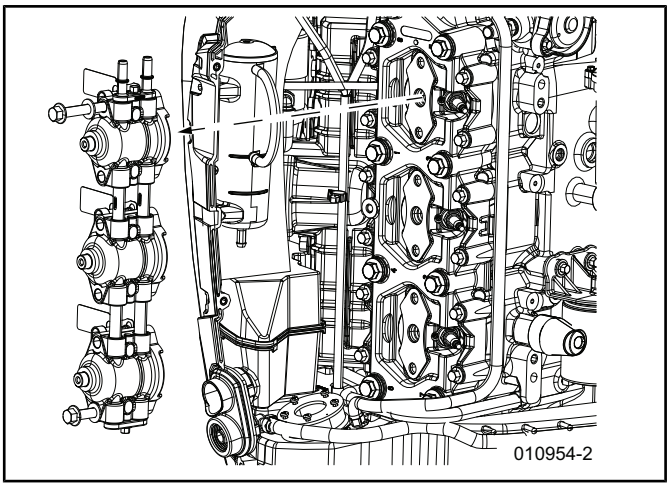
10. Remove the upper screw of the bottom fuel injector.
11. Loosen the lower screw of the bottom fuel injector several turns.

NOTE: Do NOT remove the lower screw.

12. Remove BOTH screws from the middle injector.
13. Remove the lower screw from the TOP injector then loosen the upper screw several turns.

NOTE: Do NOT remove the upper screw.

14. Remove the upper screw from the TOP injector. Support the injector bank in place on the cylinder head.
15. Continue to support the injector bank in place while removing the lower screw from the BOTTOM injector.
16. Detach the lower screw from the cylinder head.
17. Remove the bank of fuel injectors from the cylinder head.

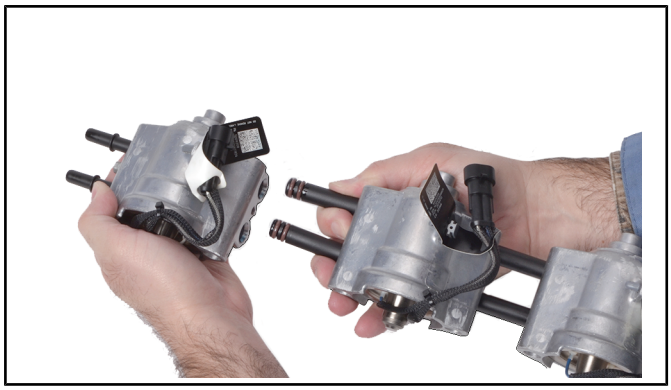


18. Use a suitable container to drain fuel from the injectors.

19. Take the bank of fuel injectors to a work bench or other suitable work surface.
20. Remove fuel injector insulators from the cylinder head.

Fuel Injector Bank Disassembly

1. Carefully pull each injector to separate it from the fuel tubes.



2. Remove the screw retaining the fuel fitting to the top injector.
3. Remove the fitting from the injector.
4. Remove the screw retaining the fuel fitting to the bottom injector.
5. Remove the plug fitting from the injector.
6. Remove the O-rings from the fuel fitting, each fuel tube and the plug fitting.

Crush Ring Replacement

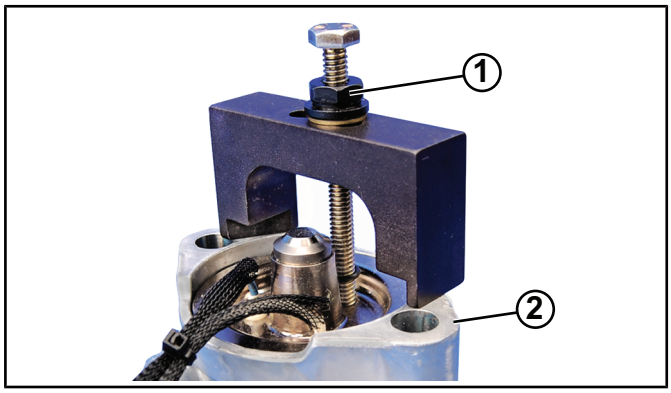
NOTICE

Injector crush rings must be replaced if injector is installed in a different head or cylinder location.

1. Use Fuel Injector Puller Kit, P/N 356461, to remove injector from mounting cup.

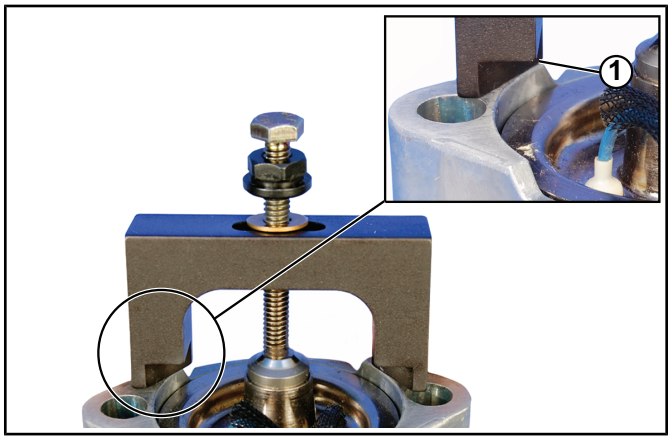
Required Tool
Fuel Injector Puller Kit **P/N 356461**

2. Turn the nut of the fuel injector puller counterclockwise several turns.
3. Place the fuel injector puller on the fuel injector housing.



1. *Puller nut*
2. *Fuel injector housing*

4. Align the angled edges of both sides of the tool base with the edge of the fuel injector housing as shown.

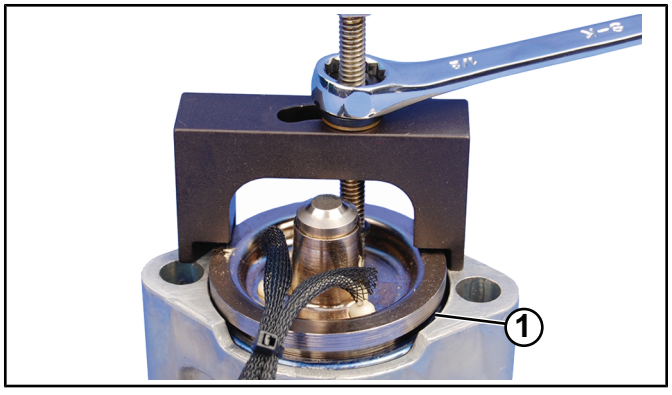


1. *Angled edge of the tool base*

5. Thread the puller screw into the fuel injector 1/4- 20 threaded hole until it seats.

1. *1/4-20 threaded hole*

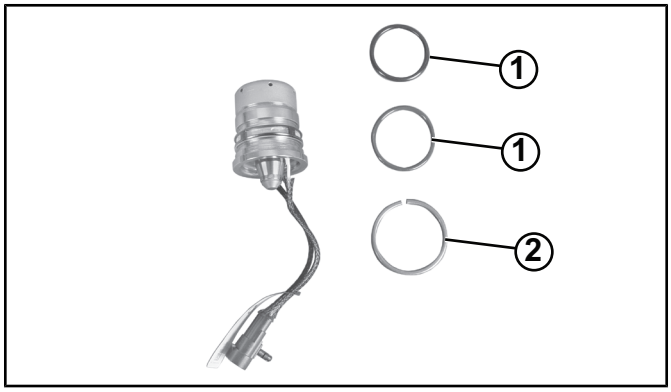
6. Turn puller nut clockwise until it contacts the puller base.
7. Use a 1/2 inch (13 mm) wrench to continue turning the puller nut clockwise.
8. Turn the puller nut until the fuel injector is removed from the fuel injector housing.



1. *Fuel injector removed from fuel injector housing*

9. Remove fuel injector puller from injector.

10. Remove crush ring and O-rings from injector.
11. Inspect and clean injector filter.
12. Install new crush ring and O-rings.
13. Lubricate O-rings with *STP Oil Treatment*.
14. Install injector into mount housing.
15. Press on injector face until injector seats in mount housing.



1. *O-rings*
2. *Crush ring*

Installation

⚠ WARNING

After servicing the fuel system check for leaks. Failure to check for fuel leakage could allow a leak to go undetected, resulting in fire or explosion.

NOTICE

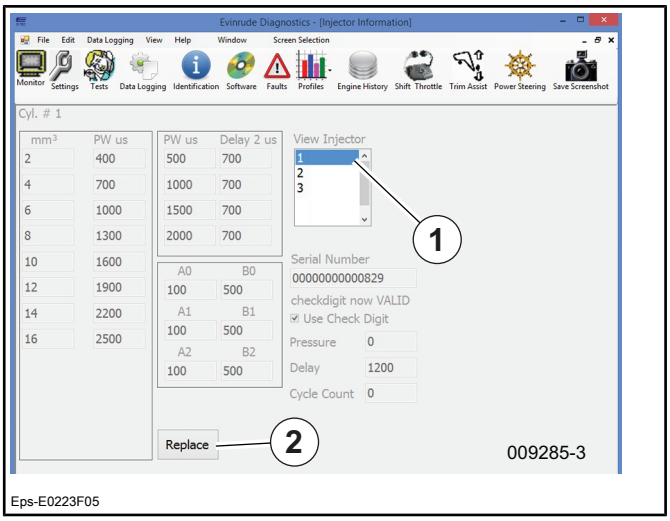
All injectors must be installed in the correct cylinder by serial number. Improper injector installation can result in powerhead failure.

Installation of a replacement injector requires that coefficient data for the new injector is uploaded to the *EMM*.

Coefficient data can be downloaded from the *Evinrude* dealer website. Refer to the instructions provided with the injector kit.

Upload Coefficient Files to EMM

1. Use the *Evinrude Diagnostics* software, v 6.4 or higher Settings screen to upload the coefficient file to the *EMM*.
2. Select the *Injectors* tab.
3. From the *View Injector* window, select the cylinder for the injector being replaced.
4. Select the *Replace* button.



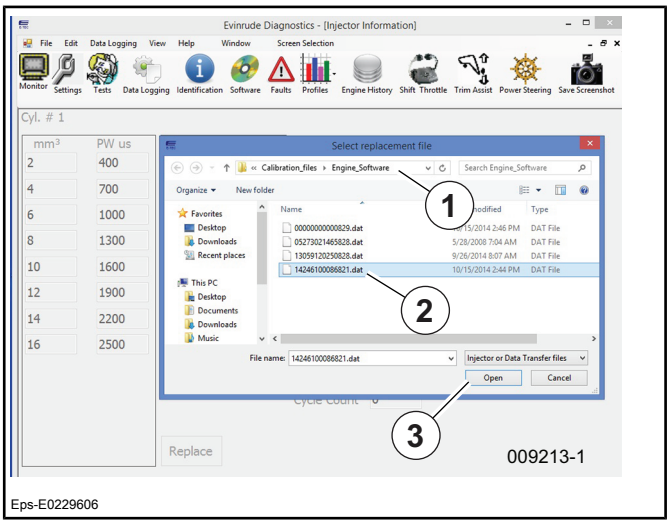
Eps-E0223F05

1. *"View Injector" window*
2. *"Replace" button*

5. Use the drop down menu to navigate to the saved coefficient file location.

NOTE: The coefficient file name must match the serial number of the injector.

6. Select the correct file for the injector.
7. Select the *Open* button.



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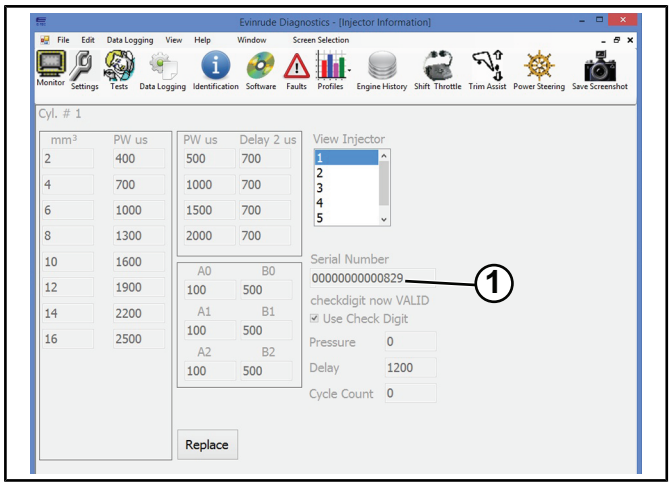
1. *Drop down menu*
2. *Injector coefficient file*
3. *"Open" button*

NOTE: After the upload is complete, the program will return to the *Injector* tab.

8. Make sure the serial number displayed on the screen matches the serial number printed on the serial number label of the replacement injector.



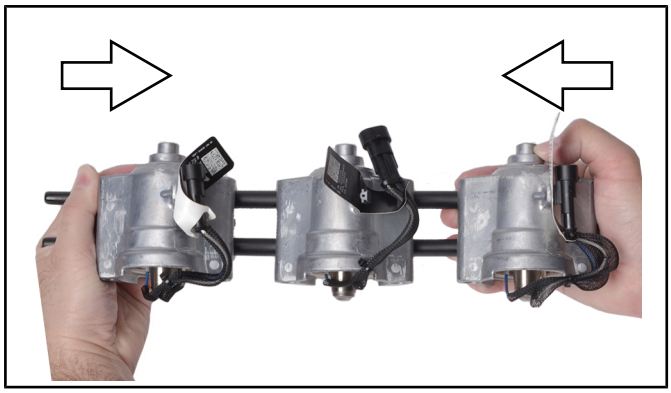
1. *Injector serial number*

Fuel Injector Installation

NOTICE

Confirm injector location when assembling the injector bank. Refer to cylinder location marks made earlier. Improper injector installation can result in powerhead failure.

1. Install new O-rings on the fuel fitting, each fuel tube and the plug fitting.
2. Apply 2-stroke outboard oil to the o-rings.
3. Install the fuel fitting in the top injector.
4. Install the retaining screw and tighten to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
5. Install the plug fitting in the bottom injector.
6. Install the retaining screw and tighten to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
7. Align the injectors with the fuel tubes and press together until fully seated.



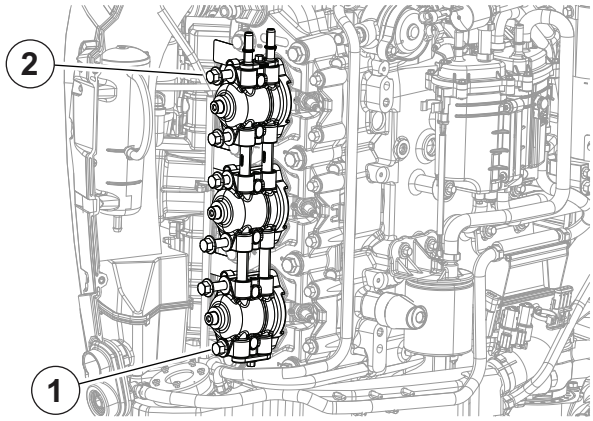
8. Clean the injector and the injector mating surface before assembly
9. Clean the cylinder head and the cylinder head mating surface before assembly.
10. Clean the threads of the screw before assembly.
11. Clean the threaded areas before assembly.

⚠ CAUTION

All injector components must be clean to ensure correct torque tightening specifications. To prevent fuel leakage, carefully follow these installation instructions.

IMPORTANT: Be careful not to pinch any wiring or hoses during assembly.

12. Install mounting screws dry. Do NOT lubricate *Armorgalv* screws.
13. Install washers (one per screw) on injector retaining screws.
14. Install screws and washers through mounting flange of injector and into cylinder head.
15. Place insulators over injectors and screws.
16. Place the injector bank into position on the cylinder head.
17. Support the injector bank in place on the cylinder head.
18. Install the lower screw into the BOTTOM injector and cylinder head FIRST.
19. Install the upper screw into the TOP injector and cylinder head SECOND.



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1. *Install the lower screw into the BOTTOM injector and cylinder head FIRST.*
2. *Install the upper screw into the TOP injector and cylinder head SECOND.*

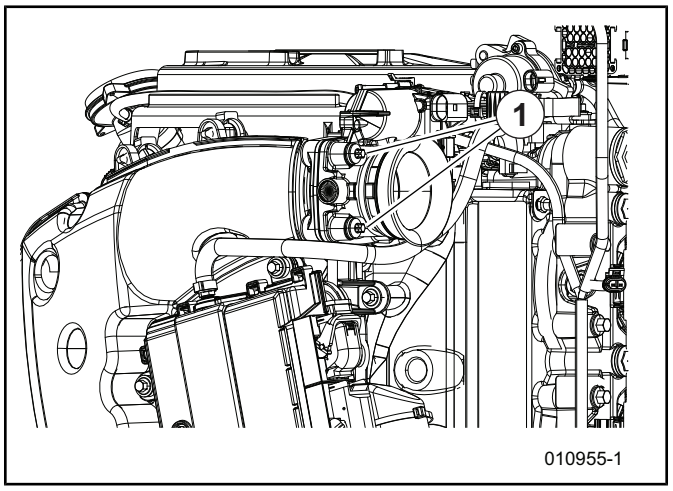
20. Install the remaining screws.
21. Tighten the screws to 84 to 108 in. lbs. (10 to 12 N·m).
22. Retighten the screws to 144 to 168 in. lbs. (16 to 19 N·m).
23. Tighten the screws a third time to 32 to 34 ft. lbs. (43.3 to 46 N·m).
24. Install fuel rails. Refer to **Fuel Rail Service**.
25. Connect the electrical connectors to the fuel injectors.

26. Position the ignition coil and bracket assemblies onto each injector.
27. Install the ignition coil bracket washers and retaining screws.
28. Connect the electrical connectors to the ignition coils.
29. Connect the battery cables at the battery.
30. Prime the fuel system and check for fuel leaks. Repair all leaks.
31. Supply water to the engine. Start and run the out-board and check for fuel leaks. Repair all leaks before returning the outboard to service.
32. Install the starboard frame.
33. Install the engine rear and top covers. Refer to **Engine Cover and Frame Service**.

Throttle Body Service

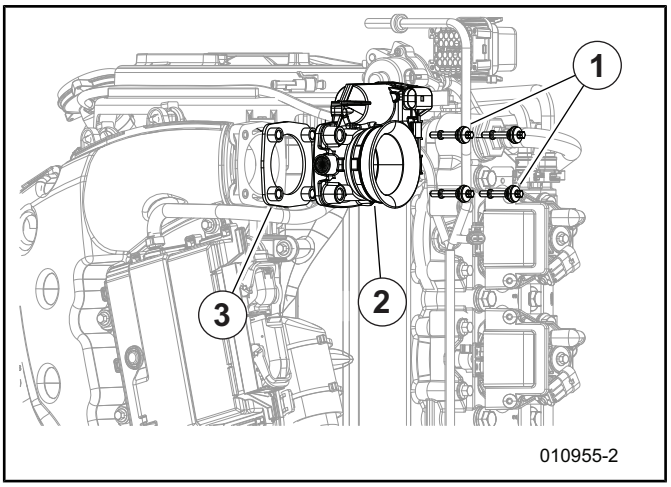
Removal

1. Disconnect the battery cables at the battery.
2. Remove the engine top, and rear covers.
3. Remove the starboard frames. Then remove the port frame. Refer to **Engine Cover and Frame Service**.
4. Disconnect the throttle body electrical connector.
5. Remove the four screws retaining the throttle valve to the air box.



1. Screws

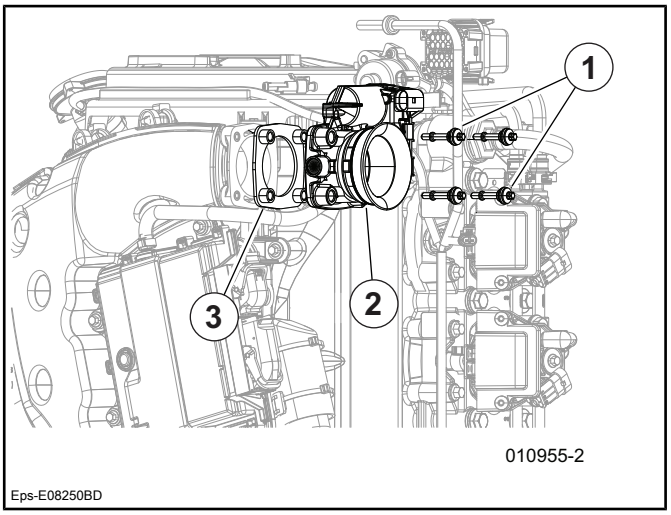
6. Remove the throttle body and seal from the air box.



1. Four screws
2. Throttle body
3. Seal

Installation

1. Install the seal into the throttle body.
2. Install the throttle body and seal onto the air box. Secure the throttle body with four screws. Tighten to a torque of 24 to 35 in. lbs. (2.7 to 4.0 N·m).



1. Four screws
2. Throttle body
3. Seal

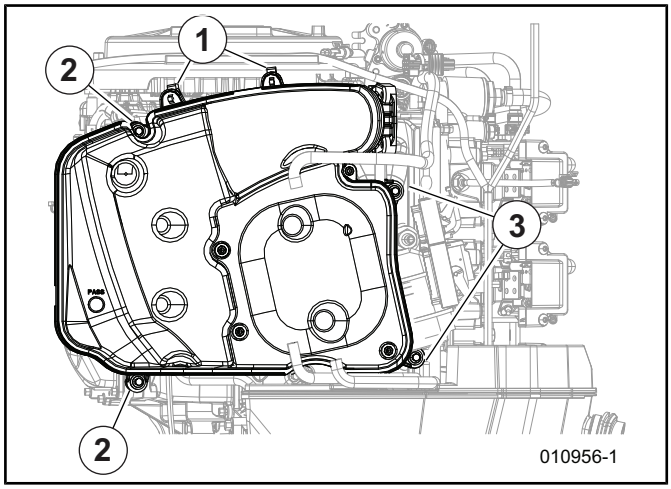
3. Connect the electrical connector to the throttle valve.
4. Install the port and starboard frames.
5. Install the engine rear and top covers. Refer to **Engine Cover and Frame Service**.
6. Connect the battery cables at the battery.

Intake Manifold Service

Removal

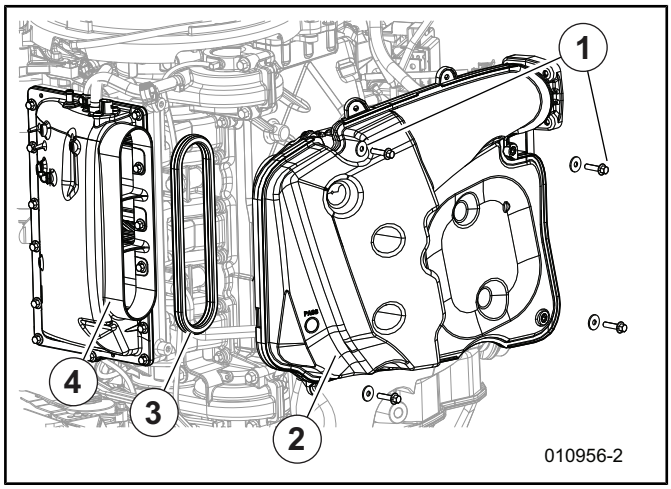
1. Disconnect the battery cables at the battery.
2. Remove the engine top and rear covers.

3. Remove the starboard and port frames. Refer to **Engine Cover and Frame Service**.
4. Disconnect all cables and hoses at the engine.
5. Remove the four retaining screws from the rigging housing and remove the rigging housing.
6. Remove the throttle body from the air box. Refer to **Throttle Valve Service**..
7. Remove the *EMM* from the air box. Refer to ***EMM* Servicing**.
8. Release the mounting clips and remove the engine harness from the clips.
9. Remove two screws and washers retaining the air box to the plenum and two screws and washers retaining the air box to the cylinder block.



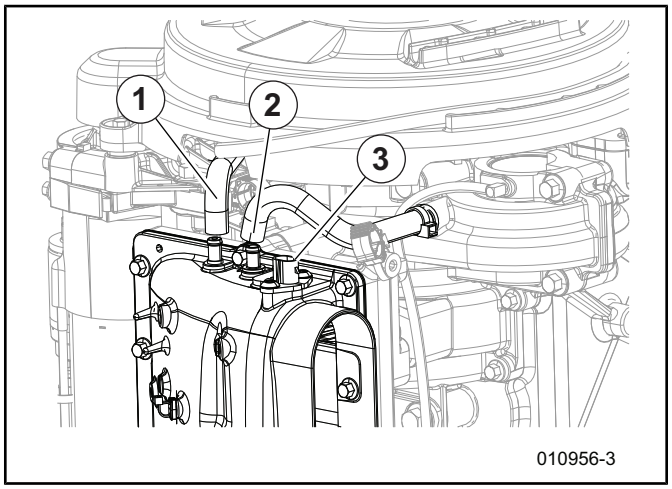
1. *Mounting clips*
2. *Two screws and washers (plenum)*
3. *Two screws and washers (cylinder block)*

10. Remove the air box and seal from the plenum.



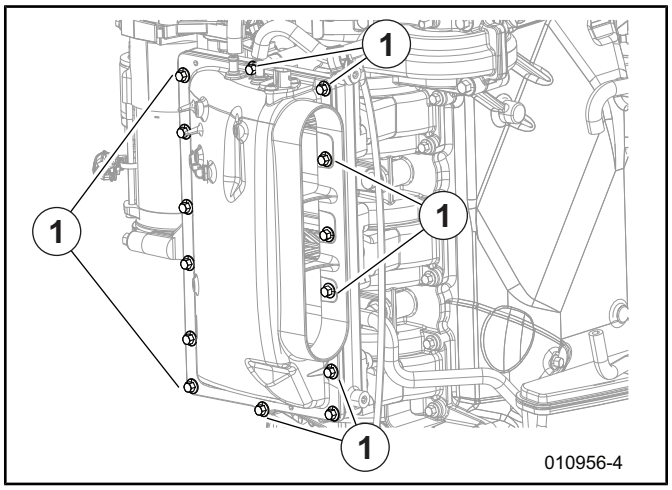
1. *Screws and washers (4)*
2. *Air box*
3. *Seal*
4. *Plenum*

11. Remove the *Oetiker* clamp from the vapor solenoid vent hose. Remove the hose from the plenum.
12. Remove the tie strap from the balance gear vent hose. Remove the hose from the plenum.
13. Disconnect the air temperature sensor.



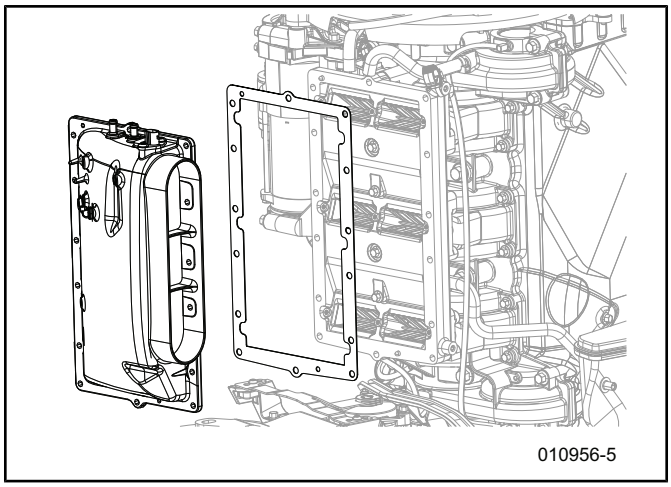
1. *Vapor solenoid vent hose*
2. *Balance gear vent hose*
3. *Air temperature sensor*

14. Remove the clamp and vent hose from the plenum.
15. Remove 14 retaining screws from the plenum.



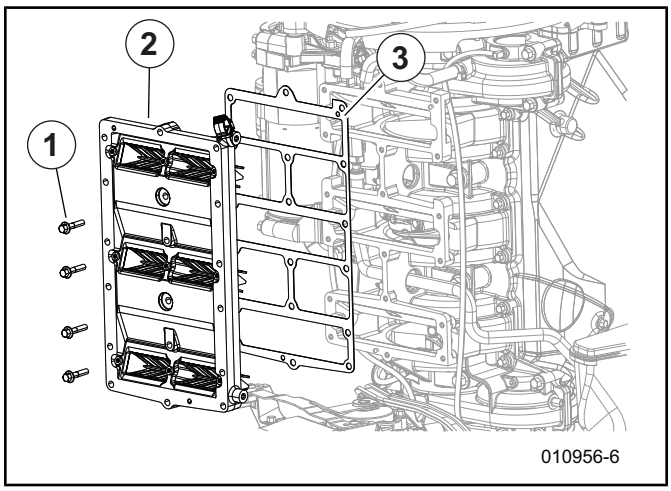
1. *Screws (14)*

16. Remove the plenum and gasket.



PLENUM AND GASKET

17. Remove 4 retaining screws from the reed plate assembly, then remove the reed plate and gasket from the crankcase.



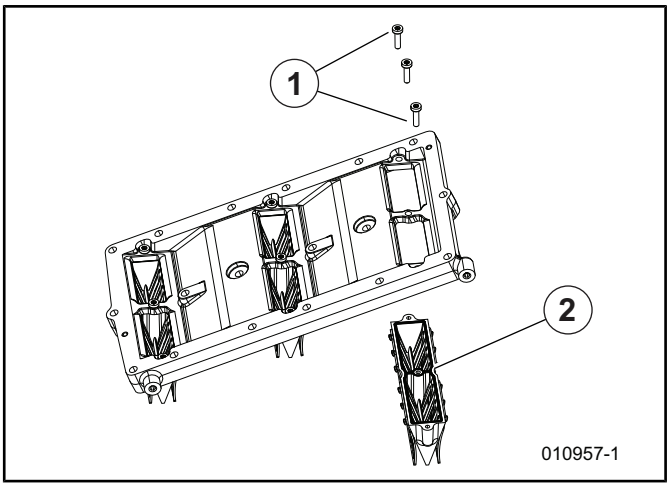
1. *Four screws*
2. *Reed plate assembly*
3. *Gasket*

Disassembly

1. Thoroughly clean the reed plate assembly and reed valve assemblies.

NOTE: DO NOT use strong carburetor cleaner or the hot soaking tank method for cleaning.

2. Remove the three reed valve retainer screws from each reed valve assembly. Then remove each assembly.



1. *Reed valve retainer screws*
2. *Reed valve assembly*

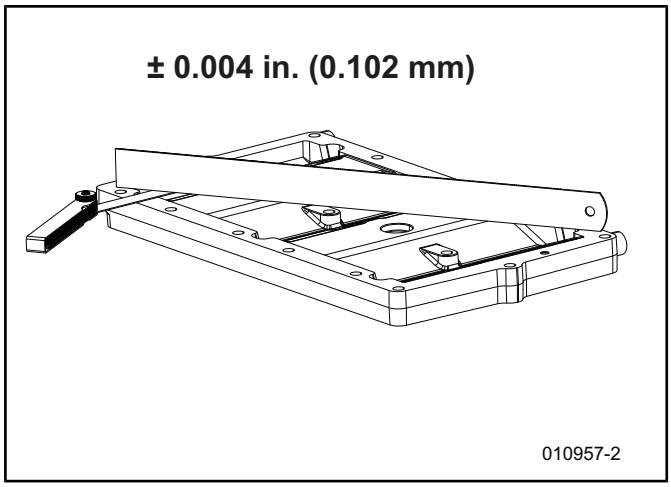
3. Use caution to prevent damaging reed valve assemblies.

NOTICE

DO NOT disassemble reed valve assemblies. Damaged reed plates are not serviceable and are replaced as an assembly.

Inspection

1. Inspect the leaf plate assemblies for damage or contamination.
2. Inspect the leaf plates for distortion.
3. Inspect the leaf plates for cracks or chips.
4. Inspect the leaf plate stops. The leaf plate stops must not be distorted or loose.
5. Inspect the leaf plate assemblies for cleanliness.
6. Inspect the intake manifold. All gasket surfaces must be cleaned, smooth, and free of nicks. Use a machinist's straight-edge and a feeler gauge to check flatness in all directions. Surface must be flat, ±0.004 in. (0.10 mm).

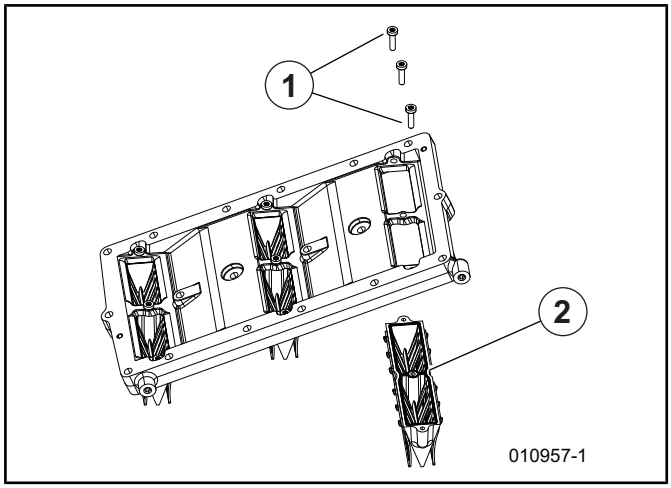


Assembly

1. Remove old adhesive from reed valve retaining screws.
2. Prime screw threads with *Locquic Primer* and let dry.

Required Chemical
Nut Lock
P/N 500418

3. Apply *Nut Lock* to threads of the reed valve retainer screws.
4. Position the reed valve assembly on the reed plate and install screws.
5. Tighten screws to a torque of 30 to 42 in. lbs. (3.5 to 4.7 N·m).



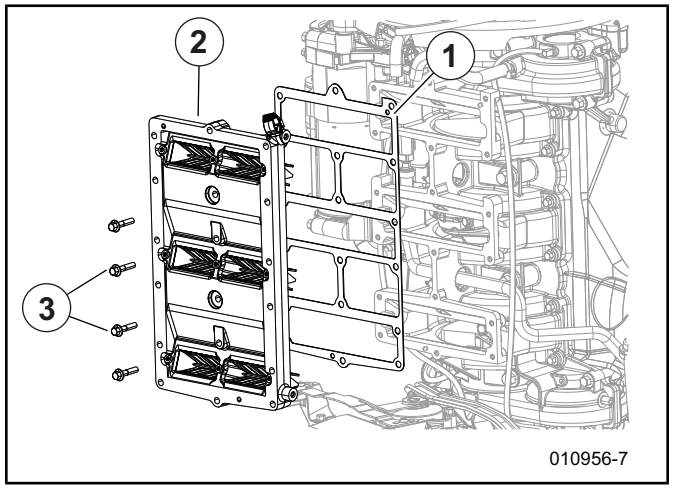
1. Reed valve retainer screws
2. Reed valve assembly

Installation

1. Install a new gasket on the reed plate assembly.

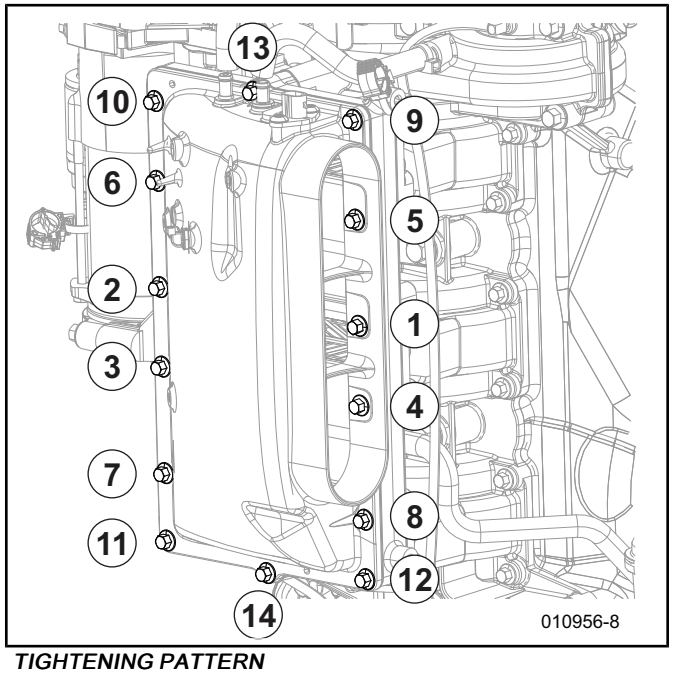
NOTE: DO NOT use sealer on the gasket.

2. Place reed plate assembly on cylinder/crankcase.
3. Install all screws.
4. Tighten the center screws first and expand outward.
5. Tighten in stages to a final torque of 84 to 106 in. lbs. (10 to 12 N·m).



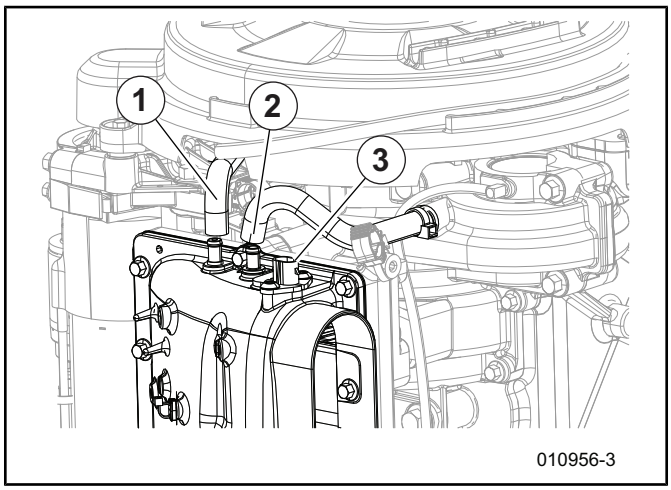
1. Gasket
2. Reed plate assembly
3. Center screws

6. Place a new gasket on the plenum.
7. Install the plenum on the reed plate and install 14 screws.
8. Tighten the screws in the pattern shown.
9. Tighten to a final torque of 84 to 106 in. lbs. (10 to 12 N·m).



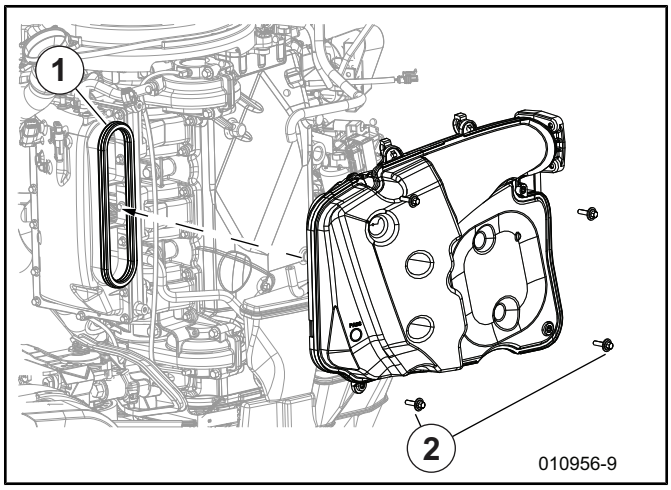
TIGHTENING PATTERN

10. Install the vent hose on the plenum and secure with a new 15.7 mm *Oetiker* clamp.
11. Install the balance gear vent hose with a new tie strap.
12. Connect the electrical connector to the air temperature sensor.



1. Vapor solenoid vent hose
2. Balance gear vent hose
3. Air temperature sensor

13. Install the seal on the plenum.
14. Apply soapy water the seal and install the air box with four washers and screws. Tighten the screws to a torque of 30 to 54 in. lbs (3.4 to 6.1 N·m).

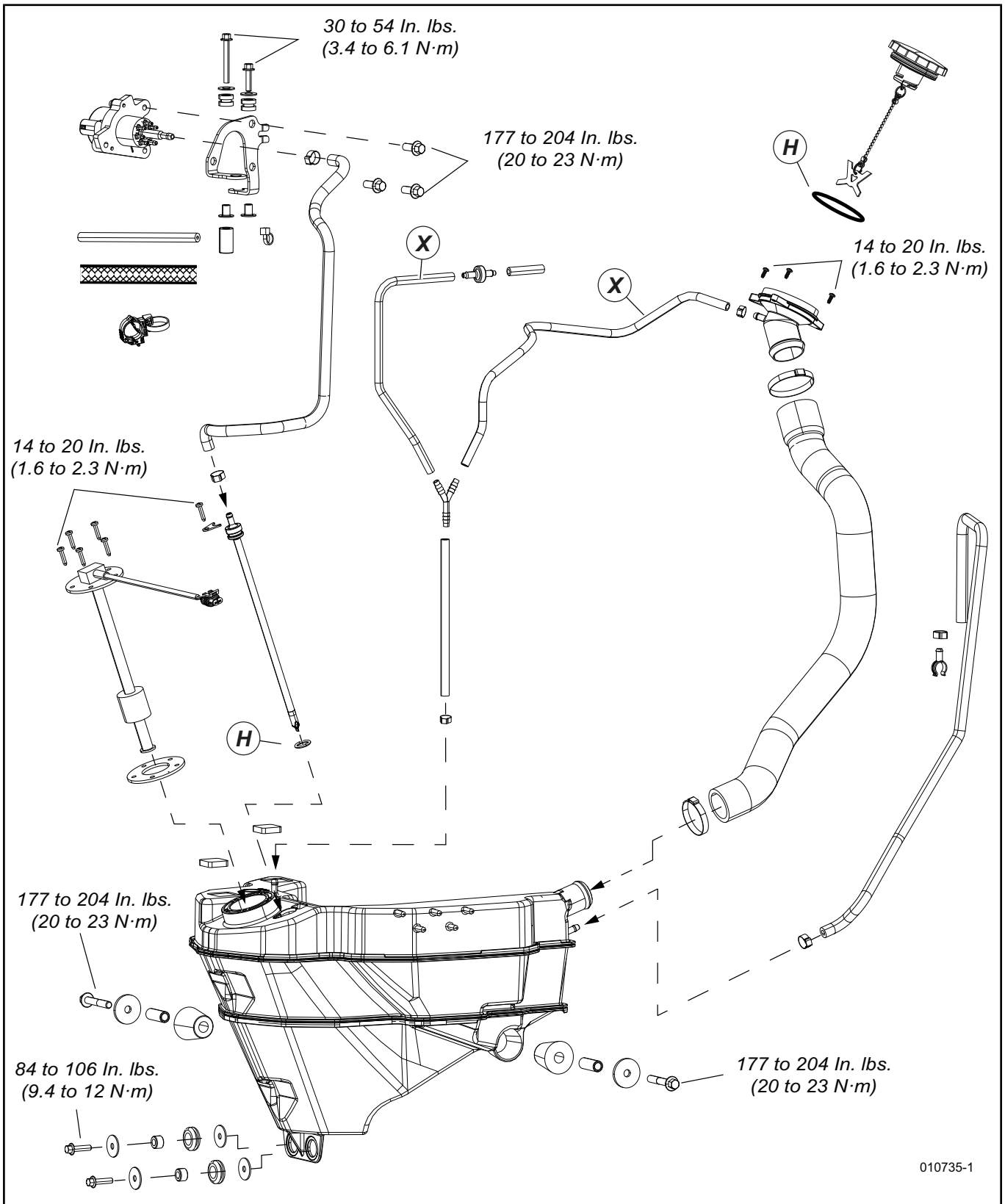


1. Seal
2. Four washers and screws

15. Install the engine harness into the mounting clips and secure the clips.
16. Install the *EMM* on the air box. Refer to ***EMM* Installation**.
17. Install the throttle body on the plenum. Refer to **Throttlebody Service**.
18. Install the rigging housing with four retaining screws.
19. Install the port and starboard frames. Refer to **Engine Cover and Frame Service**.
20. Connect all cables and hoses at the engine. Refer to **Rigging Information**, or the current ***Evinrude E-TEC G2* Inline 3– Cylinder Installation and Predelivery Guide**.
21. Install the engine front, top cover and rear covers.
22. Connect the battery cables at the battery.

Oiling System

Service Charts: Oil System



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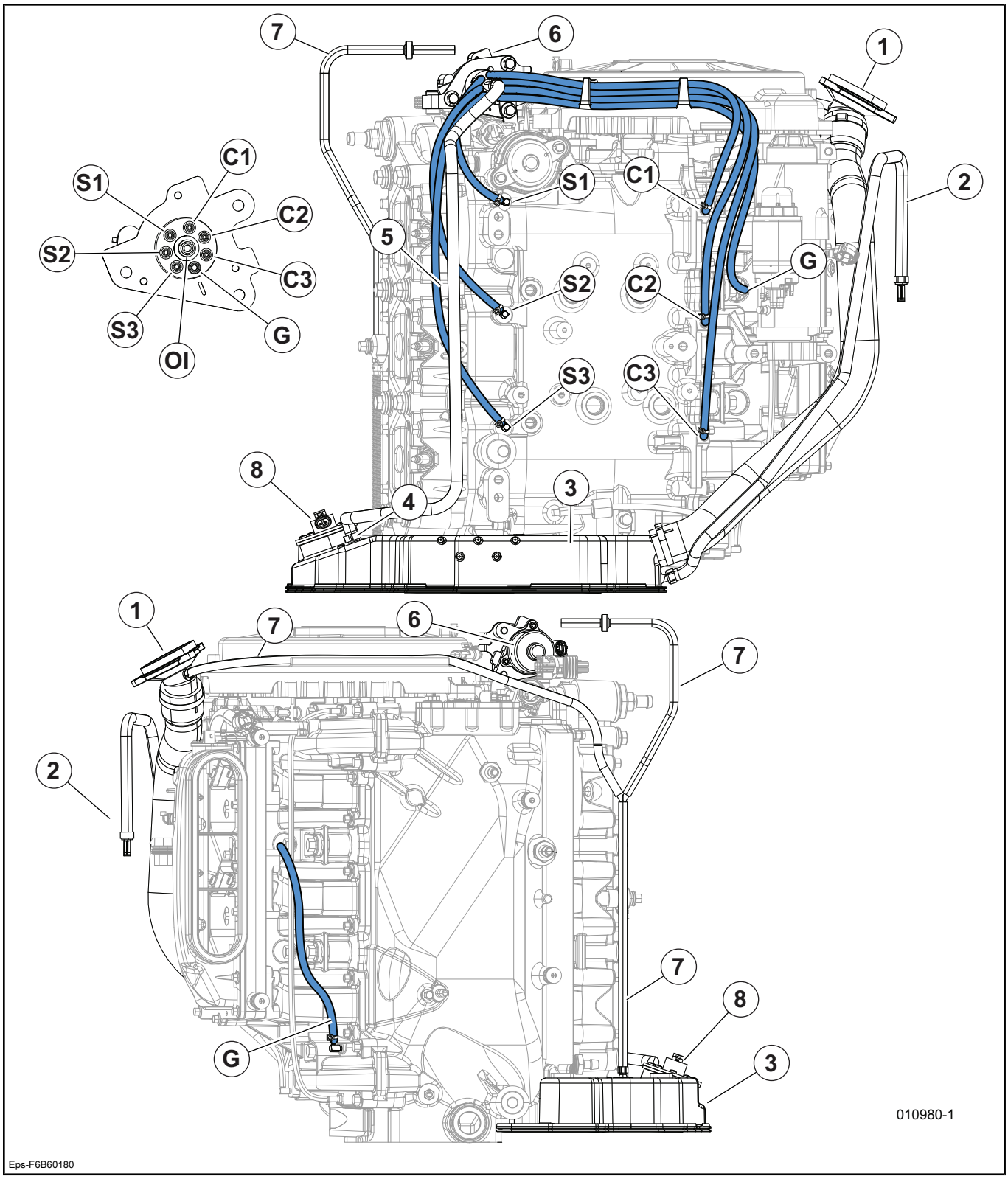
8

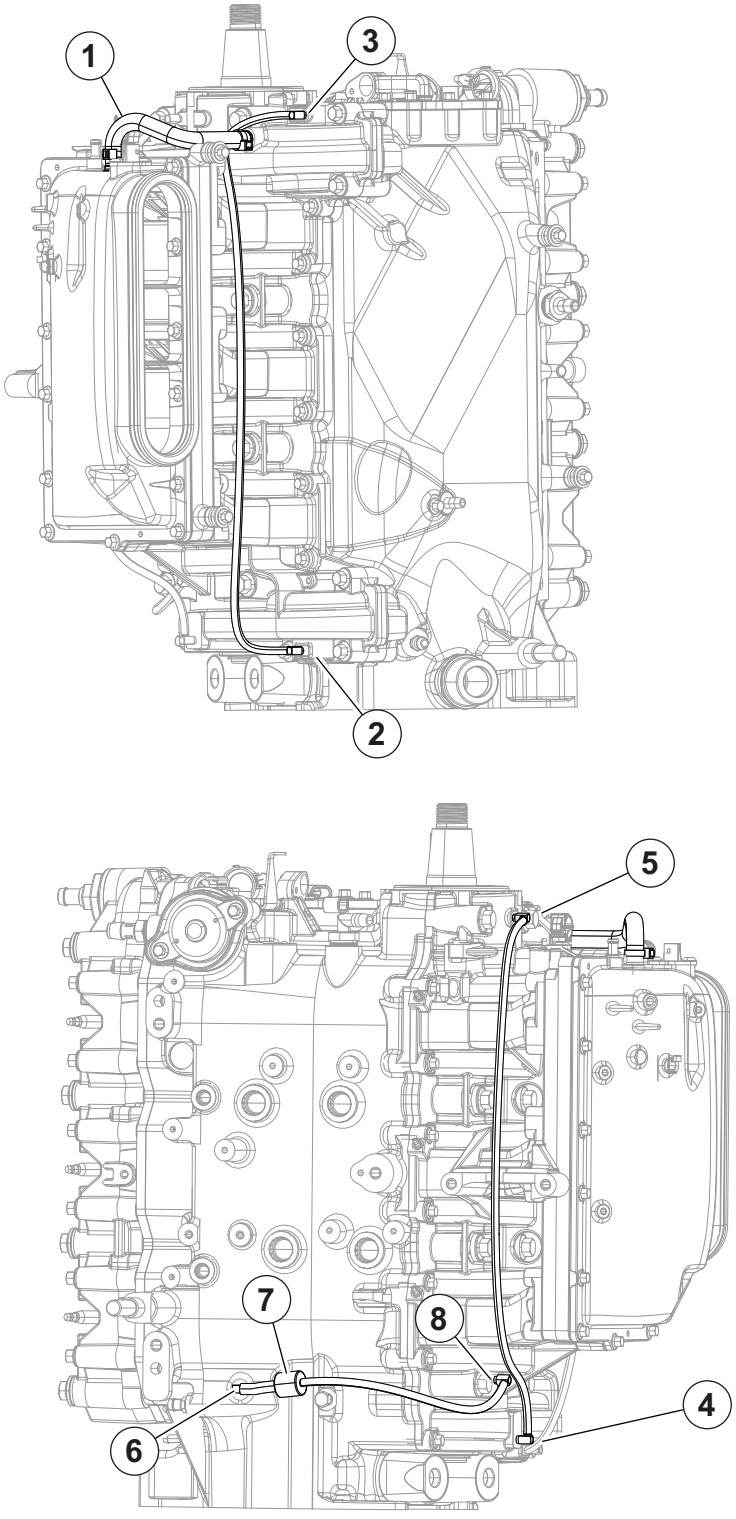
H	Outboard Lubricant	*X*	See Service Manual procedure

Oil Supply Diagrams Inline 3–Cylinder Models



1. Oil fill neck
2. Remote oil fill hose
3. Oil tank assembly
4. Oil pick up assembly
5. Oil supply hose (pick up assembly to oil pump)
6. Oil pump
7. Oil vent hose and check valve assembly
8. Oil level sender
S1 — Oil distribution hose, oil pump to sleeve (cylinder #1) — Cut to length 9.38 in. (238.25 mm)
S2 — Oil distribution hose, oil pump to sleeve (cylinder #2) — Cut to length 13.50 in. (342.90 mm)
S3 — Oil distribution hose, oil pump to sleeve (cylinder #3) — Cut to length 17.75 in. (450.85 mm)
C1 — Oil distribution hose, oil pump to crankcase (cylinder #1) — Cut to length 18.13 in. (460.50 mm)
C2 — Oil distribution hose, oil pump to crankcase (cylinder #2) — Cut to length 22.00 in. (558.80 mm)
C3 — Oil distribution hose, oil pump to crankcase (cylinder #3) — Cut to length 26.50 in. (673.10 mm)
G — Oil distribution hose, oil pump to lower balance gear — Cut to length 32.75 in. (831.85 mm)
OI — Oil supply hose, oil tank to inlet fitting

Oil Recirculation Diagram



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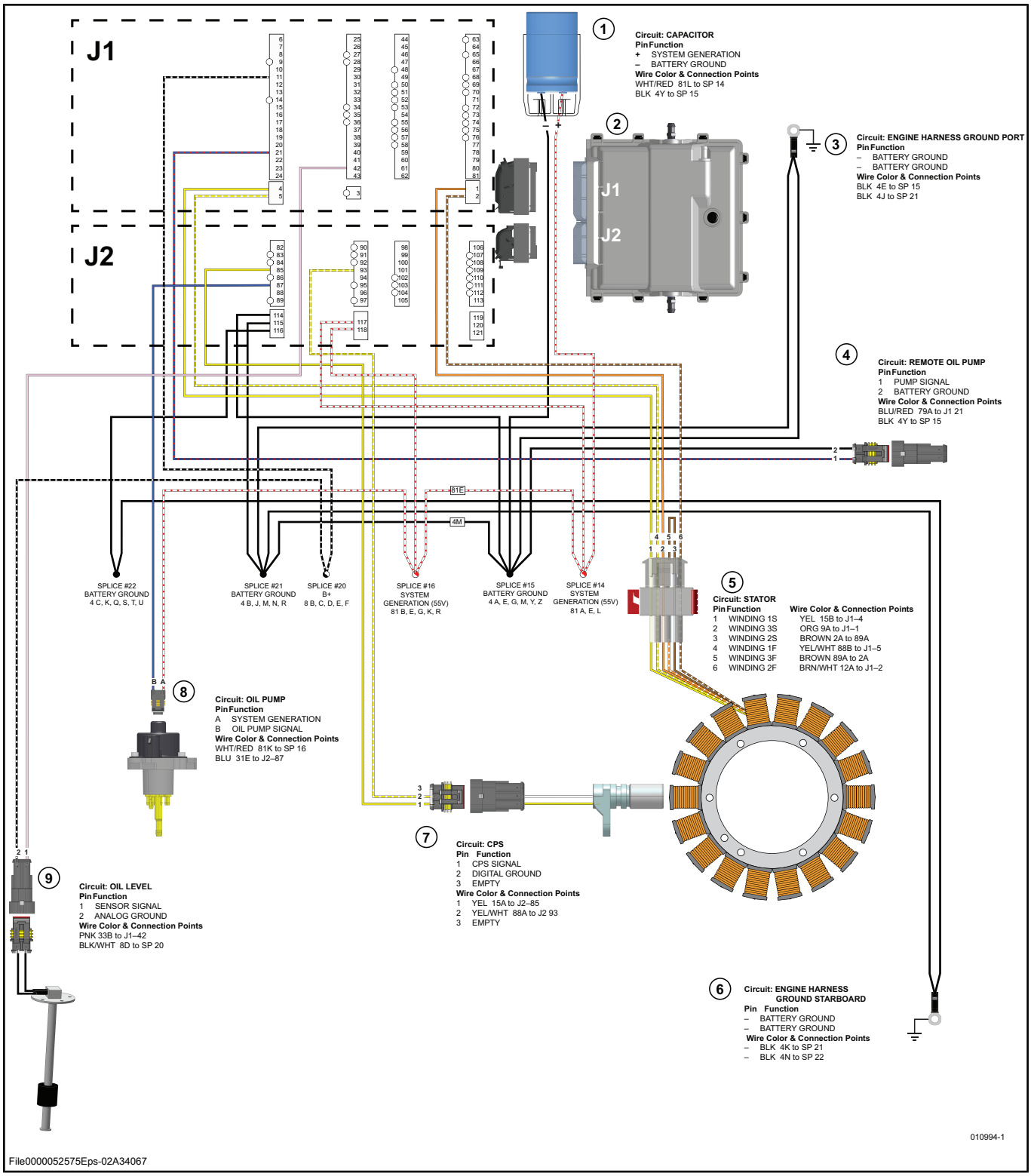
1. Vacuum hose
2. Oil outlet fitting from lower balance gear bearing
3. Oil inlet fitting to upper balance gear bearing
4. Oil outlet fitting from lower main bearing
5. Oil inlet fitting to upper main bearing
6. Oil outlet fitting from cylinder #3
7. Check valve
8. Oil inlet fitting to lower main bearing

Oil System Circuit Diagram



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LEGEND	
B +	Battery Positive
B –	Battery Negative (ground)
BLK	Black
BLU	Blue
BRN	Brown
CAN	Controller Area Network
GND	Ground
GRN	Green
GRY	Gray
J1	EMM J1 Connector
J2	EMM J2 Connector
ORG	Orange
PNK	Pink
PPL	Purple
RED	Red
SP	Splice
TAN	Tan
WHT	White
YEL	Yellow

Component List	
1	Capacitor
2	EMM
3	Remote Oil Pump Connector
4	Stator
5	Engine Harness Ground (Starboard)
6	Crankshaft Position Sensor (CPS)
7	Oil Pump
8	Engine Harness Ground (Port)
9	Oil Level Sender

2–Stroke Engine Oil Requirements

NOTICE

When operating in conditions under 32°F (0° C), Evinrude XPS Marine XD100™ oil must be used.

Evinrude Oil Brands

Evinrude XPS Marine XD 2–stroke outboard oils are formulated to give best engine performance while controlling piston and combustion chamber deposits, providing superior lubrication, and ensuring maximum spark plug life.

The following 2–stroke outboard oils are recommended for use in your *Evinrude E-TEC* outboard:

- Evinrude XPS Marine XD100™ Direct Injection Oil
- Evinrude XPS Marine XD50™ 2–Stroke Oil
- Synthetic TC-W3 NMMA-certified oil

Evinrude XPS Marine XD100™ oil is preferred for your *Evinrude E-TEC* outboard. This synthetic formula oil provides uncompromised lubrication and superior performance, even in extreme conditions especially in cold temperatures down to 0°F (-17° C).

NOTICE

DO NOT add automotive type 4–stroke oils to 2–stroke engine oil tank(s). Do not add oil to the fuel.

Failure to follow oil specifications could void the engine warranty if a lubrication-related failure occurs.

Recommended Lubricants

NOTICE

Failure to follow these recommendations could void the outboard warranty if a lubrication related failure occurs.

XPS MarineXD100, or *XD50* outboard oils are recommended for use in *Evinrude E-TEC G2* outboards. If these oils are not available, use a *NMMA® TC-W3®* Certified SYNTHETIC oil.

XPS Marine XD100 outboard oil is highly recommended for all conditions and applications.

Checking Oil Level

Make sure the outboard is in the vertical position when checking oil level. Use the digital gauge or display to check the oil level.

Optional Remote Oil Tank

The following optional accessory kits are available for use with *Evinrude E-TEC G2* models:

- Remote Oil Tank Kit, 1.8 gallons (6.8 liters), P/N 5010829
- Remote Oil Tank Kit, 3.0 gallons (11.3 liters), P/N 5010830
- Oil Tank Pick-up Kit, P/N 767686, for the 10 gallon (37.8 liters) capacity oil tank

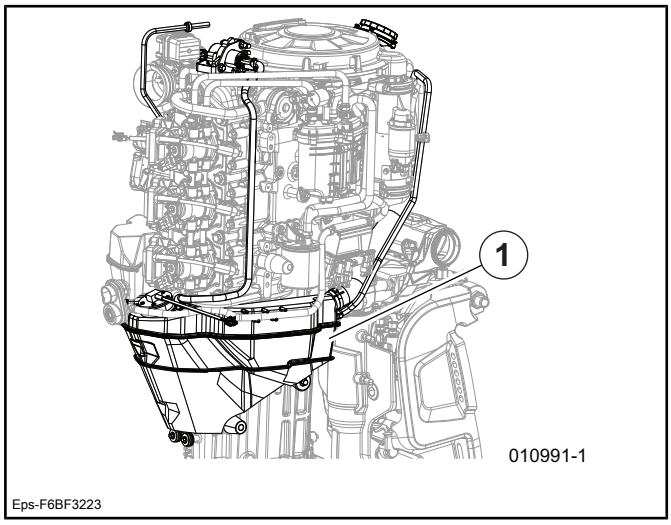
Components

The oiling system consists of the following components:

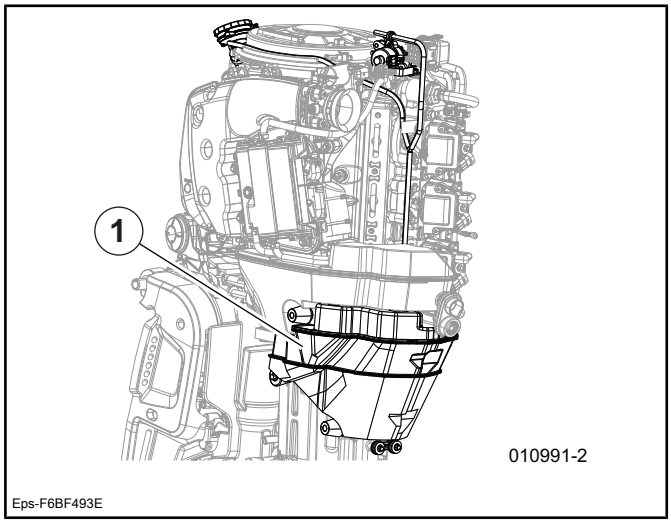
– Oil tank
– Oil pump assembly
– Electrical circuit
– Oil level sender
– LOW OIL and NO OIL warning systems
– Oil recirculation system

Oil Tank Assembly

The oil tank assembly wraps around the exhaust housing of the outboard. Oil level must be monitored.



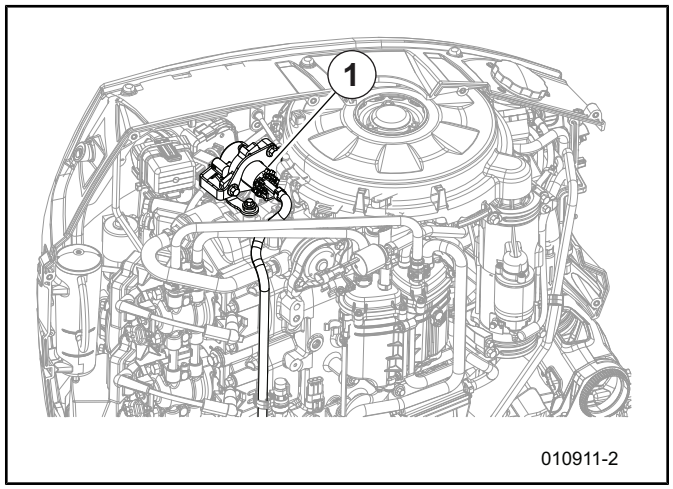
1. Oil tank (Starboard View)



1. Oil tank (Port View)

Oil Pump

The oil pump is a positive displacement piston-style pump, actuated by an electric solenoid. The *EMM* supplies 55 V and controls activation of the pump. The pump draws oil from the oil tank and supplies pressurized oil to the cylinder sleeves, crankcase and lower balance gear oil fittings.



1. Oil pump assembly

Electrical Circuit (55 V)

The oil pump is powered by the 55 V electrical circuit. The *EMM* controls pump operation by rapidly connecting and disconnecting the pump's internal coil to ground.

The *EMM* monitors the oil pump electrical circuit. If the *EMM* detects an open circuit in the harness or oil pump, the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 34
– Engine Monitor NO OIL display: ON

Oil Level Sender

An oil level sender mounted in the oil tank monitors oil level and transmits oil level information to a *NMEA 2000* network. Oil level changes are transmitted in 5% increments. The *EMM* calculates and tracks oil level based on "Remaining Oil Pulses" based on the known volume of an oil pump pulse. There are 35,156 pulses when the oil level is at 100% capacity.

If equipped with *ICON* Touch digital displays, the oil level sender signals the *ICON* Touch display to activate the LOW OIL warning through a *NMEA 2000* network. See **LOW OIL Warning**.

LOW OIL Warning

If the oil level falls below approximately 25% capacity, the *EMM* signals:

– Engine Monitor LOW OIL display: ON

Approximate oil reserve at LOW OIL activation is 1.6 qt. (1.5 l).

NOTE: If equipped with *ICON Touch* digital displays, the sending unit in the oil tank signals the *ICON Touch* display to activate the LOW OIL warning through a *NMEA 2000* network.

NO OIL Warning

When the oil level falls below 25%, the *EMM* begins counting “Remaining Oil Pulses.” When it reaches 2,600 pulses the *EMM*:

– Activates *S.A.F.E.*
– Stores fault code 117
– Engine Monitor NO OIL display: ON

To recover from *S.A.F.E.* mode:

– Oil level must be above 25%
– The operator must trim the outboard down far enough to cover the oil pick up assembly.
– The *EMM* initiates a recovery process, rapidly activating the oil pump after the outboard has been stopped and restarted.

If outboard has been run for more than 5 hours with NO OIL faults (codes 34 and 117), the *EMM*:

– Activates SHUTDOWN
– Stores fault code 33
– Engine Monitor NO OIL display: FLASHING

If outboard has been run in a high trim or tilt range for more than 3 hours with NO OIL faults (codes 34 and 117), the *EMM*:

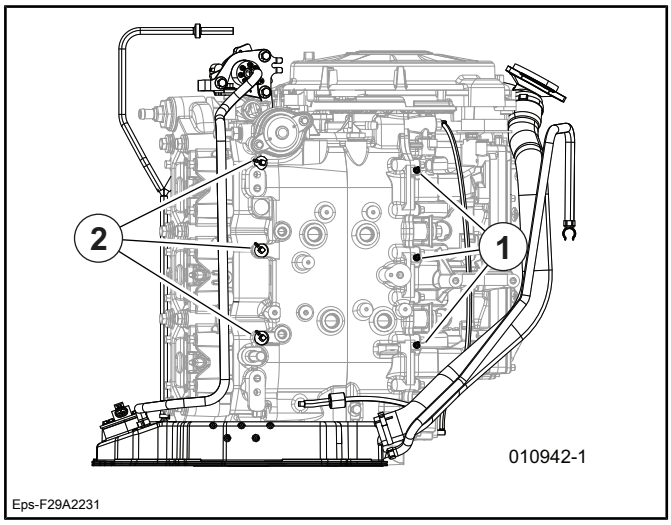
– Activates SHUTDOWN
– Stores fault code 33
– Engine Monitor NO OIL display: FLASHING

To recover from *S.A.F.E.* mode:

– Oil level must be above 25%
– The operator must trim the outboard down far enough to cover the oil pick up assembly.
– The *EMM* initiates a recovery process, rapidly activating the oil pump after the outboard has been stopped and restarted.

Cylinder and Crankcase Lubrication

The oil pump assembly provides crankcase lubrication through oil distribution hoses and pressed-in fittings at the front of the crankcase, starboard side. The oil pump assembly also provides cylinder lubrication through oil distribution hoses and pressed-in fittings in the cylinder block, starboard side.

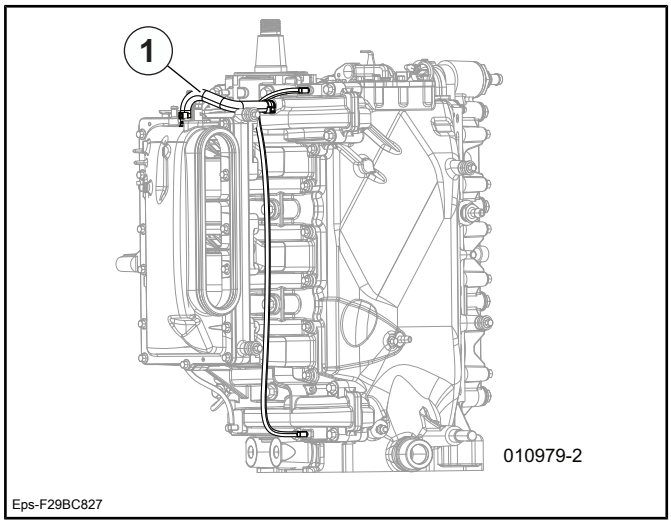


1. *Crankcase fittings*
2. *Cylinder block fittings*

Oil Recirculation System

External hoses and fittings are used to recirculate any accumulation of oil from various locations in the powerhead. The movement of oil is controlled by crankcase vacuum and a check valve.

An external hose from the crankcase to the plenum uses the vacuum created by a running engine to move oil through the recirculation system.



1. *Vacuum hose*

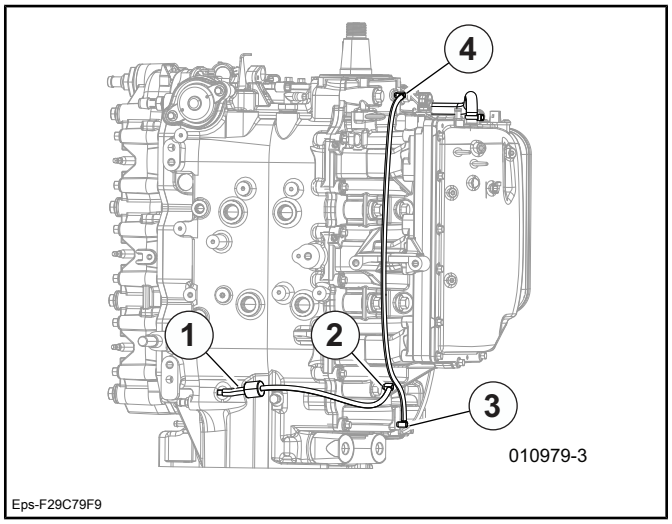
Crankcase / Main Bearing Recirculation

The movement of oil through the main bearings is controlled by internal passages, external fittings and hoses, and an in-line check valve.

The center main bearing receives oil through grooved passages in the crankcase. Oil migrates to the bearings from the crankcase areas of the higher cylinders.

The lower main bearing receives oil through a hose and check valve assembly which collects oil from the bottom of cylinder #3. Recirculated oil is deposited into the bearing cavity through a fitting on the bottom of the crankcase.

The upper main bearing receives oil through an external hose from the bottom of the crankcase. Recirculated oil is deposited into the bearing cavity through a fitting on the top of the crankcase.



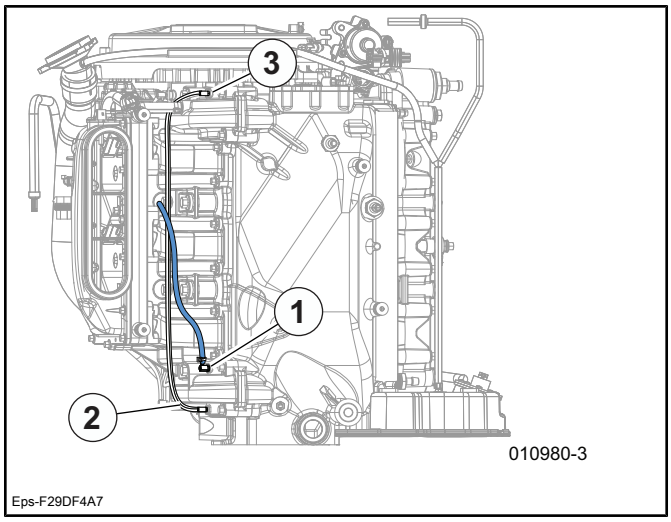
1. *Hose and check valve assembly*
2. *Fitting to lower main bearing cavity*
3. *Hose*
4. *Fitting to upper main bearing cavity*

Balance Gear Lubrication

The oil pump assembly provides oil to the lower balance gear bearings through an oil distribution hose and fitting in the crankcase.

Vacuum moves oil collected at the bottom of the lower balance gear bearing cavity through an external hose. Recirculated oil is deposited into the upper balance gear bearing cavity through a fitting on the top of the crankcase.

Oil that accumulates in the upper balance gear cavity then flows to the center main bearing.



1. *Oil distribution hose (from oil pump) and fitting*
2. *Hose*
3. *Fitting to upper balance gear bearing cavity*

Break-In Oiling

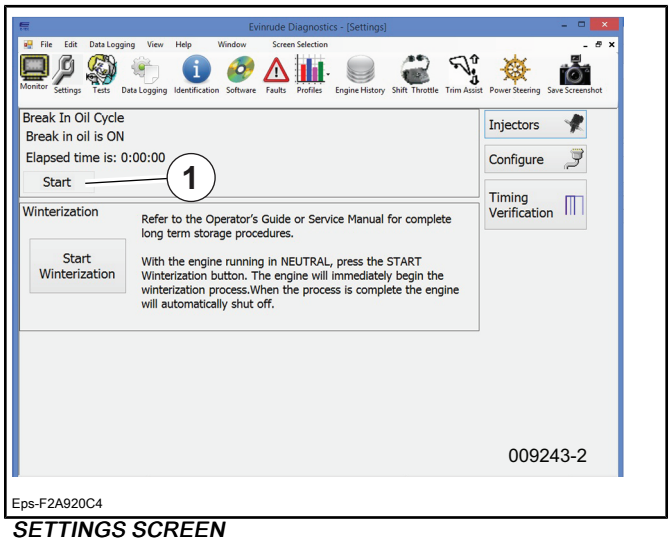
NOTICE

The operator must monitor the oil tank level to confirm oil consumption. This may require several hours of operation above idle.

IMPORTANT: DO NOT add oil to the fuel tank on *Evinrude E-TEC* models.

The *EMM* automatically supplies extra oil to the engine for the first two hours above 2000 RPM.

– Use *Evinrude Diagnostics* software, v 6.4 or higher to make sure the break-in program has been started.
– Use the diagnostics software to start break-in oiling after a powerhead rebuild.



SETTINGS SCREEN

1. *Break-in oil setting*

Oil Supply Priming

⚠ WARNING

Always use caution while working around machinery with moving parts. The following procedures require running tests that are performed with the outboard's motor cover removed.

The oil system of *Evinrude E-TEC G2* outboards is primed at the factory.

Priming the oiling system is only required if:

– The oil tank is run out of oil
– The oil system is disassembled for service or parts replacement

After refilling an empty oil tank or servicing the oil system, air MUST be removed from the system before operating the outboard.

Use *Evinrude Diagnostic* software v 6.4 or higher to prime the oil system.

Oil Pump Priming

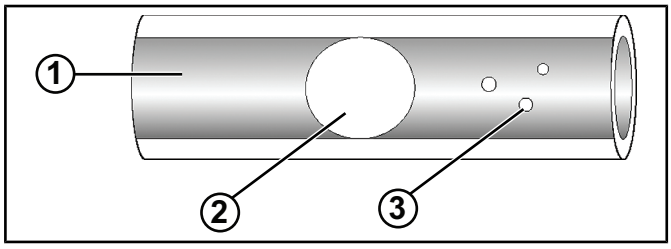
NOTICE

The oiling system MUST be primed to avoid engine damage from a lack of lubrication.

Use the *Tests/Prime Oil Pumps* function in *Evinrude Diagnostics* software to make sure air is completely purged from the oil system.

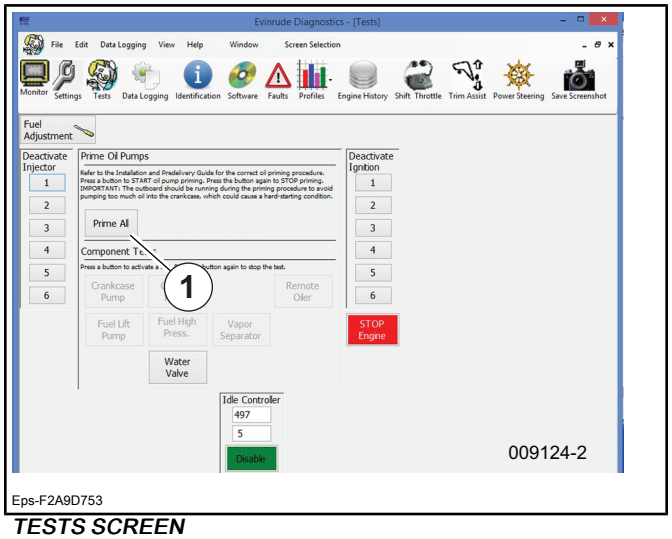
Priming Procedure

Observe oil flow through ALL oil distribution hoses during the priming procedure. Small air bubbles are acceptable. Large air bubbles must be eliminated through continued priming.



1. *Oil distribution hose*
2. *Small bubbles*
3. *Large bubbles*

1. Start the outboard.
2. Use the *Prime* button of the *Tests* screen to start the oil priming sequence.



TESTS SCREEN
1. *Prime All button*

IMPORTANT: The outboard should be running during the priming procedure to avoid pumping too much oil into the crankcase, which could cause a hard starting condition.

3. Observe oil flow through all oil distribution hoses. Air must be purged during the priming procedure.
4. After the *Prime* sequence is complete, inspect for air bubbles in the oil distribution hoses for the crankcase and the cylinders.

NOTE: If air bubbles ARE present, repeat the priming procedure. If air bubbles are NOT present, the procedure is complete.

5. Repair any oil leaks.

NOTE: The oiling system on these models can also be primed using the Self-Winterizing feature if diagnostics software is not available. Refer to the **Operator's Guide**.

8

Oiling System Tests

SERVICE TOOLS

Description	Part Number	Page
SYRINGE	P/N 346936	189

IMPORTANT: Always perform visual inspections to identify oiling system leaks. Make sure the oil tank is filled and oil supply is not contaminated.

Oil Pump Electrical Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Leads from the test probe kit can be repaired, or custom test leads can be made locally if needed. Refer to **Electrical Testing**.

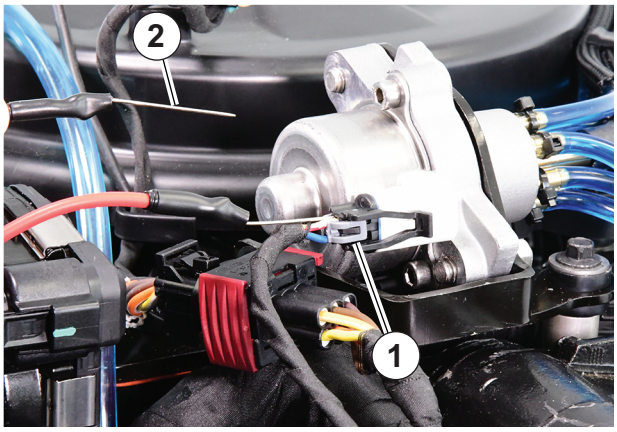
Oil system electrical circuits are dependent on wiring and connections, *EMM* supplied current and component resistance. The supplied current flows through the wiring circuit and component before returning to the *EMM*.

Circuit tests check the integrity of the main engine harness and *EMM* circuits using resistance or diode tests. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

Oil Pump Test Procedures

1. Use a digital multimeter calibrated to a scale that reads 55 V (DC) to measure voltage between the oil pump electrical connector and engine ground.
2. Connect negative meter lead to ground.
3. Use an appropriate test probe lead to connect positive meter lead to pin B (blue wire) of oil pump electrical connector.

   A test probe can be made by cutting the spring end from a #3 safety pin. For safety, dull the cut end and the sharp tip of the pin using a file or bench grinder. Solder the lead through the spring of the pin. Apply a short length of heat shrink tubing to minimize accidental shorts. This can also serve as a grip for the pin end of the lead.



1. Oil pump electrical connector
2. #3 safety pin

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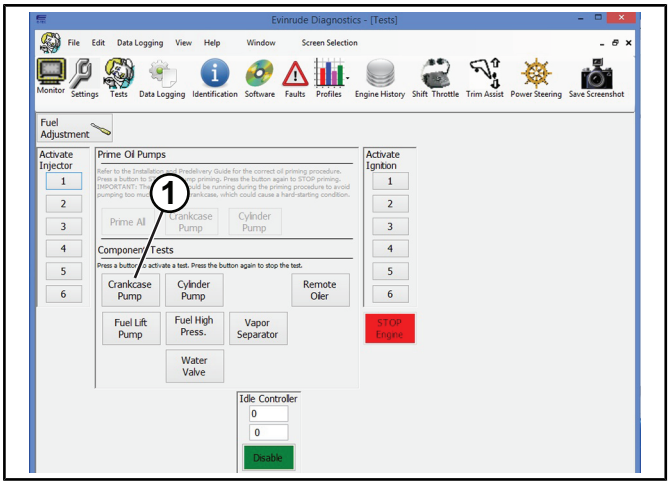
4. Turn the key switch to the ON position. Observe voltage at pin B.

NOTE: Voltage at pin B should be approximately 30 V.

5. Use the *Crankcase Pump* button of *Evinrude Diagnostic* software *Tests* screen to activate the oil pump.



TESTS SCREEN
1. Crankcase Pump button

6. Observe voltage at pin B.

NOTE: Voltage at pin B should drop as the oil pump cycles.

7. Check the control signal while the Oil Injector test is running. Set the digital multimeter to the frequency setting or the Hertz (Hz) scale.

Acceptable Oil Pump Test Readings	
Key switch ON	approximately 30 VDC
Control signal	130 to 150 Hz
Engine running	approximately 55 VDC

Results:

- If voltage and control signal readings at pin B are within range, the *EMM* and wiring are not at fault.
- If voltage at pin B is not within range, check voltage at pin A (white/red wire) of oil pump electrical connector.

8. Connect positive meter lead to pin A (white/red wire) of oil pump electrical connector. Observe voltage at pin A.

NOTE: Voltage at pin A should be approximately 30 V.

9. Start the engine. Observe voltage at pin A.

NOTE: The voltage at pin A should be approximately 55 V.

Results:

- If voltage is not within range, refer to **Oil Pump Circuit Tests** and **Oil Pump Resistance Test**.
- No voltage reading should result in Code 34; Crankcase Oil Pump Open Circuit. Refer to **System Voltage Test**.

Oil Pump Circuit Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

IMPORTANT: The complete oil pump electrical circuit includes *EMM* alternator output, the engine wire harness, the pump winding and connectors, and the oil injector control circuit of the *EMM*. Check continuity of all wiring and connections.

1. Disconnect the battery cables at the battery. Disconnect the electrical connector from the oil pump.
2. Use a digital multimeter with appropriate test probe leads to measure the resistance of the oil pump 55V circuit.
3. Connect the positive meter lead to the engine harness connector wire listed in the table.
4. Connect the negative meter lead to the red/white wire of a known good circuit such as a fuel injector.

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Oil Pump 55V Circuit Resistance		
Wire	**Pin**	**Result**
WHITE/RED	A	< 1 Ω

Results:

- An infinite reading (∞) indicates an open circuit.

5. Isolate the faulty component.
6. Check continuity of wiring and connections.
7. Repair or replace faulty wiring.
8. Use the diode test function of a digital multimeter to check the signal circuit.
9. Connect the BLACK meter lead to the wire listed in the table.
10. Connect the RED meter lead to engine ground.

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Oil Pump Signal Circuit (Diode Test)		
Wire	**Pin**	**Result**
BLUE	B	approximately 0.5 VDC

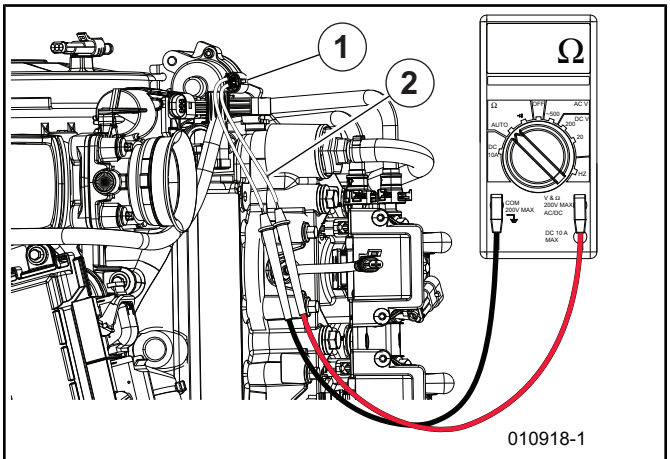
Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates a short circuit.

11. Isolate the faulty component.
12. Check wiring and connections.
13. Repair or replace faulty wiring.

Oil Pump Resistance Test

1. Disconnect the battery cables at the battery.
2. Disconnect the electrical connector from the oil pump.
3. Use a digital multimeter with appropriate test probe leads to measure the resistance between the pins of the oil pump connector.



1. *Oil pump connector*
2. *Test probe adapter leads*

Results:

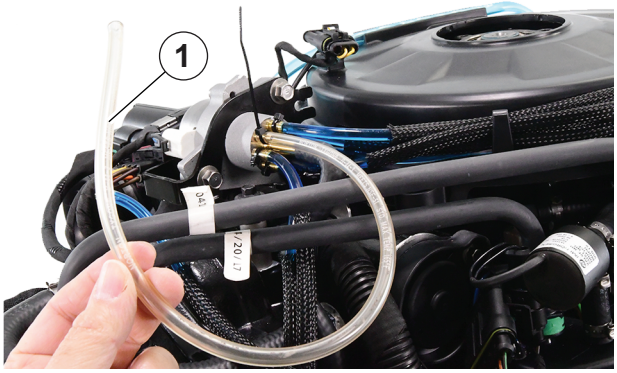
Oil Pump Coil Resistance	
Pins	**Result**
A to B	37 ± 7 Ω

- An infinite reading (∞) indicates an open circuit of the pump winding.

4. Replace faulty pump.

Oil Pump Function Test

1. Remove oil distribution hose from oil manifold. Refer to **Removal**.
2. Temporarily install a length of oil hose, P/N 778708.



1. *Hose*

Running Test

1. Start the outboard and observe oil flow.
2. Confirm that a small amount of oil is discharged while pump is activated.

Static Test

1. Use the *Evinrude Diagnostics* software oil pump test to activate the oil pump.
2. Confirm that a small amount of oil is discharged while pump is activated.

Results:

- Oil flows from distribution hose, compare to oil flow at other distribution hoses.
- If one or more fittings fail to discharge oil, replace the oil pump assembly.

After completing the tests, remove the temporary oil hose, then install the oil distribution hose(s).

Prime the oil system. Refer to **Oil Supply Priming**.

Oil Fittings Flow Test

1. Make sure the oil fittings of the cylinder and crankcase assembly allow fluid to move.
2. Remove oil distribution hose from crankcase fitting.
3. Temporarily install a length of oil hose on the fitting.

Required Tool
Syringe P/N 346936

4. Use a Syringe, P/N 346936, filled with isopropyl alcohol to force fluid through hose and fitting.

Oil Level Sender Resistance Test

1. Remove the electrical connector from the oil level sender.
2. Use a digital multimeter with appropriate test probe leads to measure the resistance of the oil level sender.

Oil Level Sender Resistance		
Float Position	**Pin**	**Result**
Up (Full)	-	30 Ω
Down (Empty)	-	240 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

3. Isolate the faulty component.
4. Check wiring and connections.
5. Repair or replace faulty wiring.

Oil Level Sender Circuit Test

1. Remove the electrical connector from the oil level sender.
2. Use the diode test function of a digital multimeter to check the signal circuit.
3. Connect the BLACK meter lead to the wire listed in the table.
4. Connect the RED meter lead to engine ground.

Oil Level Sender Circuit Diode Test		
Wire	**Pin**	**Result**
PINK	1	0.5 VDC

Results:

– No reading (OL or ∞) indicates an open circuit.
– A reading of zero (0) indicates an short circuit.

5. Isolate the faulty component.
6. Check wiring and connections.
7. Repair or replace faulty wiring.
8. Use a digital multimeter with appropriate test probe leads to measure the resistance of the oil level sender ground circuit.
9. Connect the positive meter lead to the engine harness connector wire listed in the table.
10. Connect the negative meter lead to engine ground.

Oil Level Sender Ground Circuit Resistance		
Wire	**Pin**	**Result**
BLACK/ WHITE	2	< 1 Ω

Results:

– An infinite reading (∞) indicates an open circuit.

11. Isolate the faulty component.
12. Check wiring and connections.
13. Repair or replace faulty wiring.

Oil Component Servicing

⚠ WARNING

To prevent accidental starting while servicing, disconnect the battery cables at the battery.

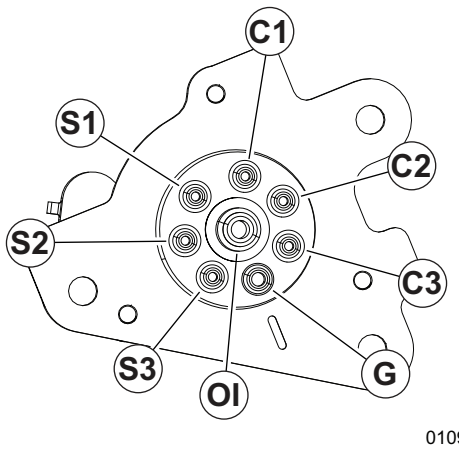
Oil Distribution Hoses

ENVIRONMENTAL NOTE

Dispose of used oil or oil contaminated shop towels in an environmentally responsible manner, or according to local regulations.

IMPORTANT: If replacing oil distribution hoses, note hose routings before proceeding with disassembly.

The oil distribution hoses from the oil pump MUST be the cut to length. DO NOT alter the length of any hoses.



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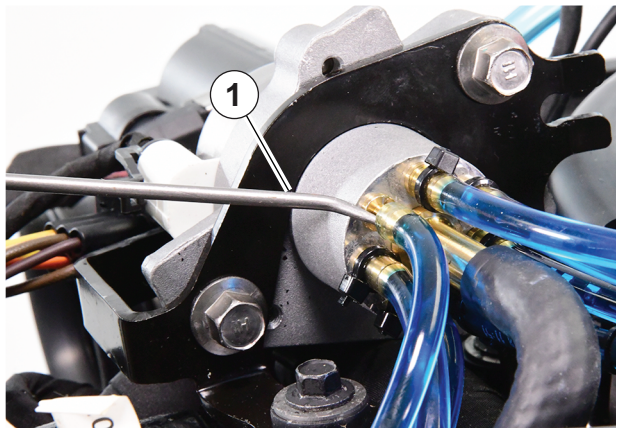
OIL PUMP

S1 — Oil distribution hose, oil pump to sleeve (cylinder #1) — Cut to length 9.38 in. (238.25 mm)
S2 — Oil distribution hose, oil pump to sleeve (cylinder #2) — Cut to length 13.50 in. (342.90 mm)
S3 — Oil distribution hose, oil pump to sleeve (cylinder #3) — Cut to length 17.75 in. (450.85 mm)
C1 — Oil distribution hose, oil pump to crankcase (cylinder #1) — Cut to length 18.13 in. (460.50 mm)
C2 — Oil distribution hose, oil pump to crankcase (cylinder #2) — Cut to length 22.00 in. (558.80 mm)
C3 — Oil distribution hose, oil pump to crankcase (cylinder #3) — Cut to length 26.50 in. (673.10 mm)
G — Oil distribution hose, oil pump to lower balance gear — Cut to length 32.75 in. (831.85 mm)

Removal

1. Cut the tie strap (s). Remove oil distribution hose(s) from the fitting(s) on the oil pump assembly. To ease removal use a miniature pick such as *Snap-On* SG3ASH45C to loosen and push the hose off the fitting.



1. Miniature pick

2. Cut tie straps and remove oil distribution hoses from the oil fittings on the crankcase and/or cylinder block.

Installation

1. Cut Replacement Oil Hose, P/N 361607, to the correct length. Refer to **Oil Supply Diagrams**.
2. Be sure the hoses are fully installed on the oil pump fittings.
3. Fasten with tie straps.
4. Route oil distribution hoses from the oil manifold to the oil delivery fittings as they were before removal. Refer to **Oil Supply Diagrams**.
5. Connect oil hoses to crankcase oil fittings and fasten with tie straps.
6. Connect oil hoses to cylinder oil fittings on the cylinder head and fasten with tie straps.

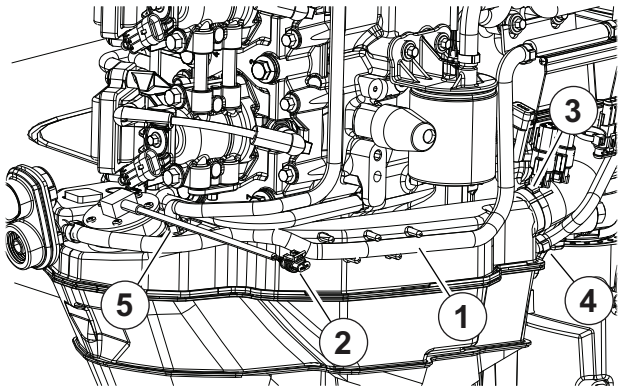
7. Prime the oil system. Refer to **Oil Supply Priming**.
8. Check oil flow through oil distribution hoses.
9. Run the outboard and check for leaks.
10. Repair any oil leaks.
11. Install the starboard frame.
12. Install the engine top cover and rear cover. Refer to **Engine Cover and Frame Service**.

Oil Tank Servicing

ENVIRONMENTAL NOTE
Dispose of used oil or oil contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Oil Tank Removal

1. Disconnect the battery cables at the battery.
2. Remove the engine top and rear covers.
3. Remove the starboard frame. Then remove the port frame. Refer to **Cover and Frame Removal**.
4. Remove oil from the oil tank. Use shop towels to clean up any spilled oil.
5. Remove the muffler. Refer to **Exhaust Relief Muffler Service**.
6. Remove the cooling water hose from the retainer on the oil tank. Move the hose and overboard indicator and grommet out of the way.
7. Disconnect the electrical connector from the oil level sender.
8. Remove the clamps from the following hoses: oil fill, remote oil tank fill, oil supply to oil pump and oil tank vent.



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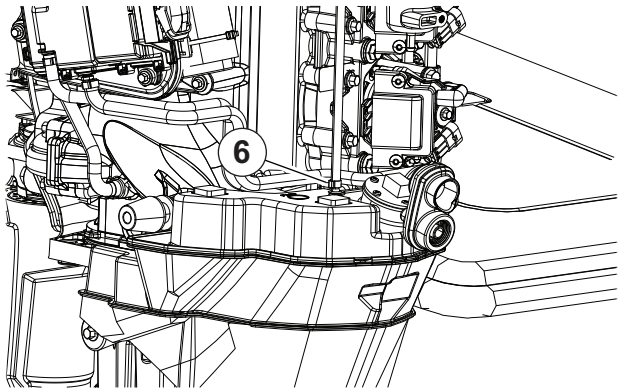

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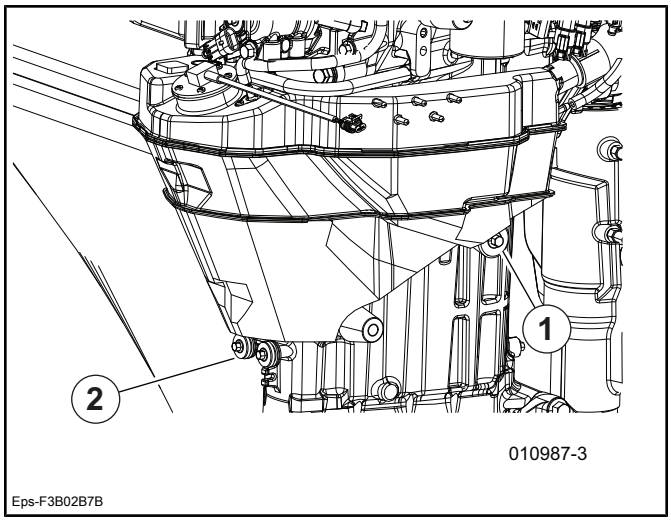
1. *Cooling water hose*
2. *Electrical connector*
3. *Oil fill hose*
4. *Remote oil fill hose*
5. *Oil supply hose*
6. *Vent hose*

9. Remove the hoses from their fittings. Plug the hoses and cap the fittings on the oil tank to prevent debris from entering the oil system while servicing.
10. Use a 10mm socket to remove the screws, washers and rubber mounts from the port and starboard sides of the oil tank.
11. Use an 8mm socket to remove the screws, washers and rubber mounts from the rear of the tank

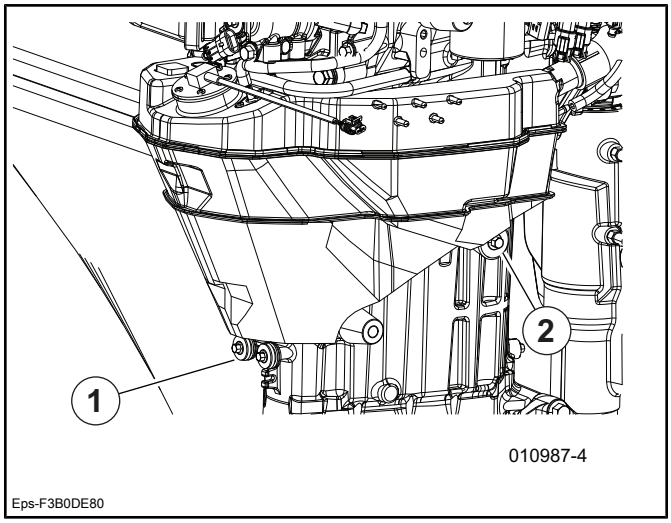


1. Starboard mount screws
2. Rear mount screws

12. Remove the oil tank from the outboard.

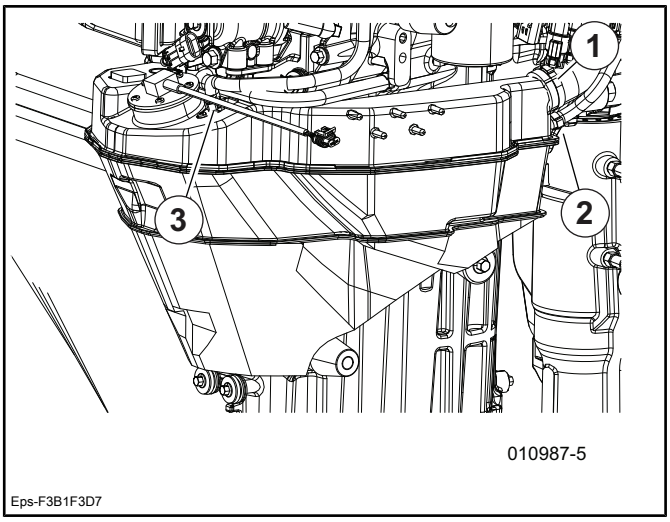
Oil Tank Installation

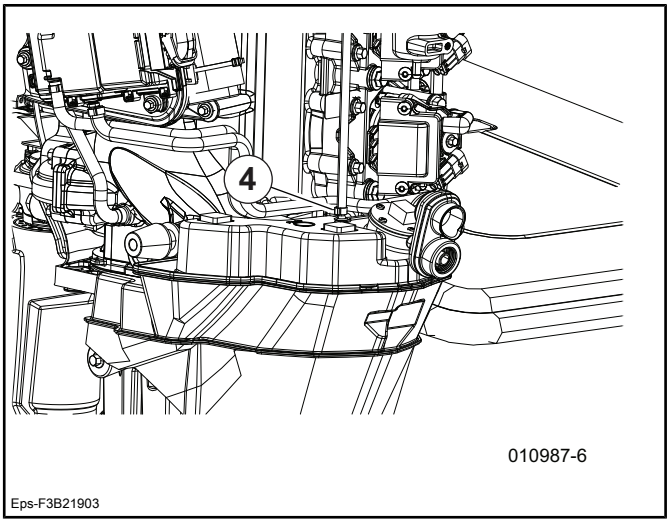
1. Install the oil tank onto the outboard.
2. Install the rubber mounts on the rear of the oil tank with two washers and two screws. Install the rubber mounts on the port and starboard sides of the oil tank with two washer and two screws. Use a 10mm socket to tighten the screws to a torque of 180 to 204 in.lbs. (20.5 to 23 N·m). Use an 8mm socket to tighten the rear screws to a torque of 84 to 106 in.lbs. (9.5 to 12 N·m). Use a 10mm socket to tighten the screws to a torque of 180 to 204 in.lbs. (20.5 to 23 N·m).



1. Rear mount screws
2. Side mount screws (starboard side shown)

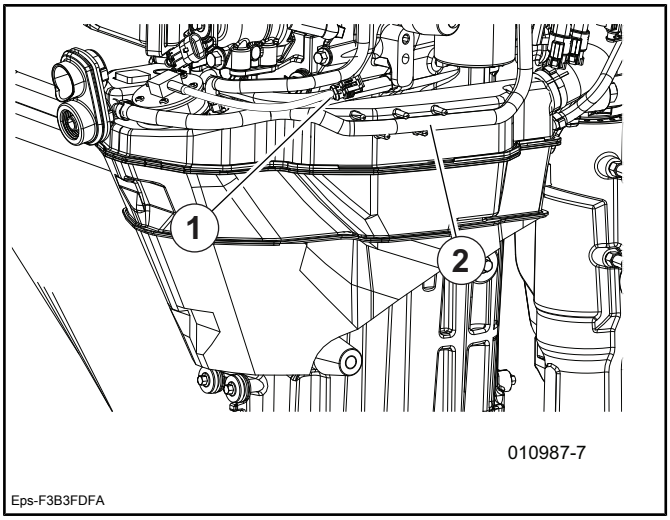
3. Install the oil fill, remote oil fill, oil supply to oil pump and oil tank vent hoses on their fittings. Secure each hose with a new *Oetiker* clamp.





1. Oil fill hose
2. Remote fill hose
3. Oil supply hose
4. Vent hose

4. Connect the electrical connector from the oil level sender and store it on its mounting clip on the hose as shown. Route the cooling water hose assembly and place the hose into the retainer on the oil tank.



1. Electrical connector
2. Cooling water hose

5. Add oil to the oil tank. Use shop towels to clean up any spilled oil.
6.
7. Install the port frame. Refer to **Cover and Frame Installation**.
8. Connect the battery cables at the battery.
9. Prime the oil system. Refer to **Oil Supply Priming**.
10. Install the starboard frame, then the rear and top covers. Refer to **Cover and Frame Installation**.

Oil Pump Service

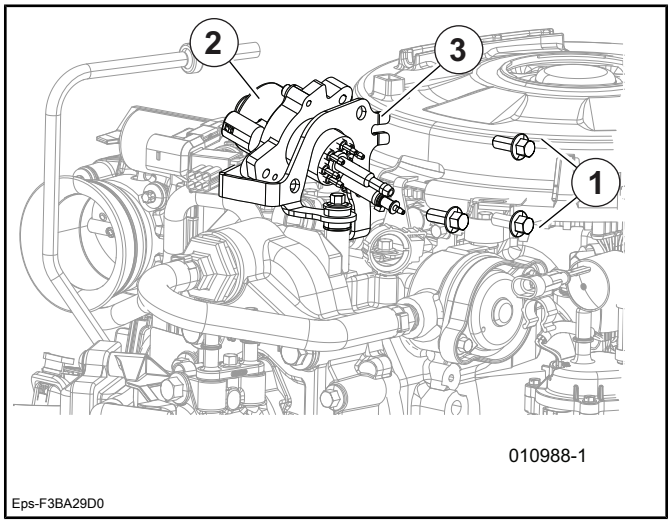
ENVIRONMENTAL NOTE
Dispose of used oil or oil contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Oil Pump Removal

1. Disconnect the battery cables at the battery.
2. Remove the engine top cover, rear cover.
3. Remove the starboard frame. The port frame does not need to be removed, but to aid access to the oil pump, unhook the rubber straps retaining the port frame to the lower/rear exhaust housing and oil pump mounting bracket. Refer to **Cover and Frame Removal**.
4. Disconnect the electrical connector from the oil pump.
5. Remove the oil distribution hoses from the oil manifold. If the oil pump will be re-installed, cap the oil distribution fittings. Refer to **Oil Distribution Hoses**.

IMPORTANT: If replacing oil distribution hoses, note hose routings before proceeding with disassembly. Refer to **Oil Supply Diagram**

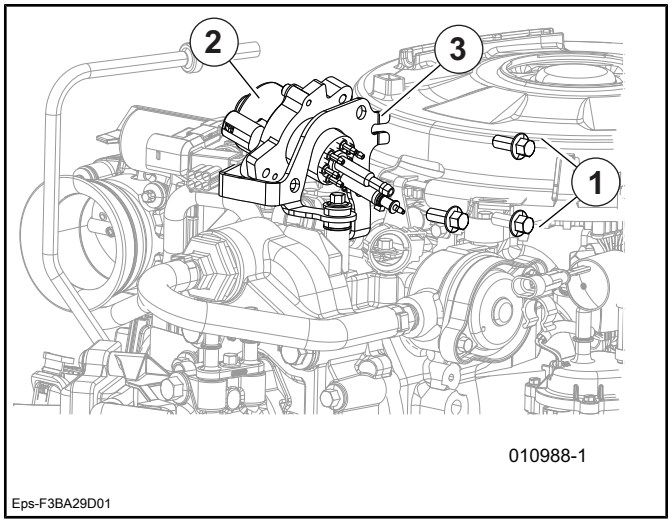
6. Remove the *Oetiker* clamp from the oil supply hose. Then remove the oil supply hose from the oil pump.
7. Plug the oil supply hose to prevent debris from entering the oil system while servicing. If the oil pump will be re-installed, cap the oil supply fitting.
8. Remove the three retaining screws from oil pump assembly.
9. Rotate the pump assembly as shown and remove the oil pump from the mounting bracket.



1. 3 screws
2. Oil pump
3. Mounting bracket

Oil Pump Installation

1. Install the oil pump into the mounting bracket.
2. Install three retaining screws. Tighten screws to a torque of 177 to 204 in.lbs. (20 to 23 N·m)



1. 3 screws
2. Oil pump
3. Mounting bracket

3. Install the oil supply hose onto oil inlet fitting on the oil pump with a new *Oetiker* clamp. Orient the ear of the clamp to prevent chafing and secure the clamp.
4. Install the oil distribution hoses onto the oil manifold. Secure the hoses with tie straps
5. Reconnect the electrical connector.
6. Prime the oil system. Refer to **Oil Supply Priming**.
7. Check oil flow through oil distribution hoses.
8. Check oil system operation and routing of oil hoses.
9. Run the outboard and check for leaks.
10. Repair any oil leaks and any kinked or improperly routed hoses.
11. Install the rubber strap retaining the port frame to the lower/rear exhaust housing and oil pump mounting bracket. Install the starboard frame.
12. Install the engine top cover and rear cover. Refer to **Cover and Frame Installation**.

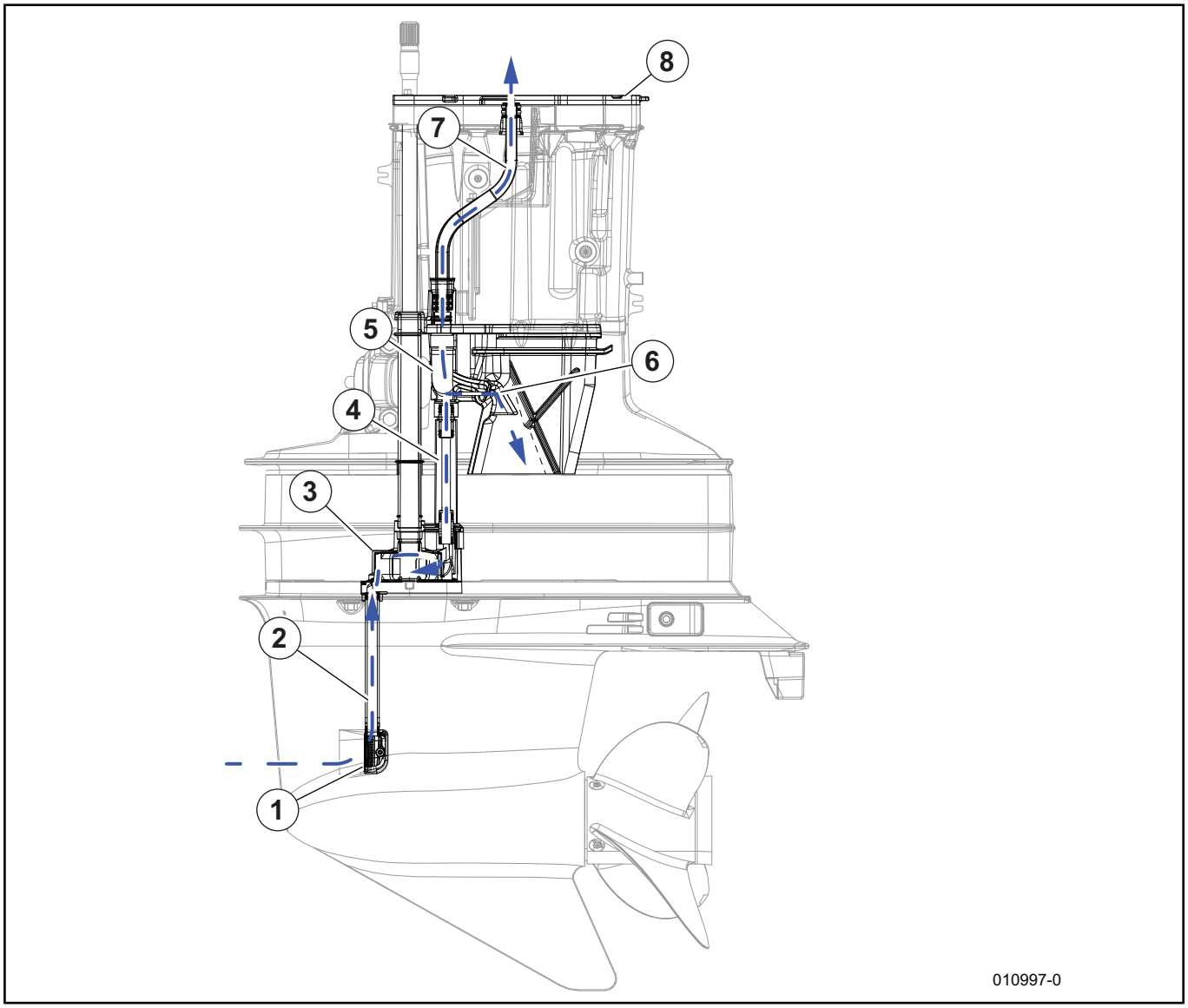
Cooling System

Water Flow and Hose Routing Diagrams

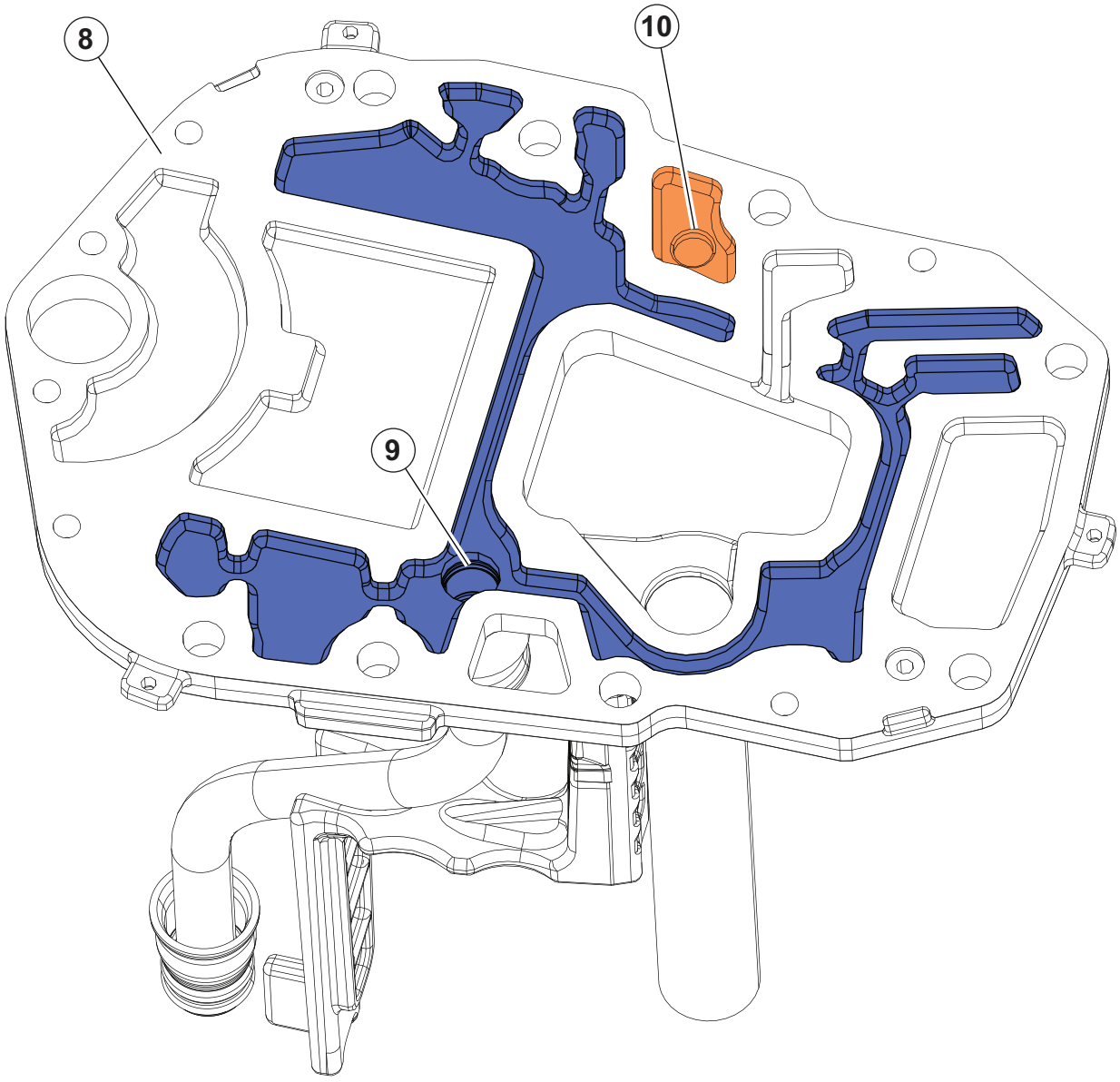
Water Flow

Cooling water enters the cooling system through water inlet screens (1) on each side of the gearcase. Water flows into a water tube (2) through a manifold on the gearcase and into the water pump (3). The water pump outlet connects with a water tube assembly (4).

Grommets seal the water tube to the water pump housing and to a lower exhaust adapter (5) located in the outboard's midsection. A drilled passage and cast deflector supply cooling water to the exhaust (6). Grommets seal a second water tube assembly (7) which connects the lower exhaust adapter to the exhaust adapter plate (8).



The exhaust adapter plate water inlet (9) supplies cooling water to the adapter plate (shaded area). The water outlet (10), features a restriction to assist in maintaining water pressure in the block.



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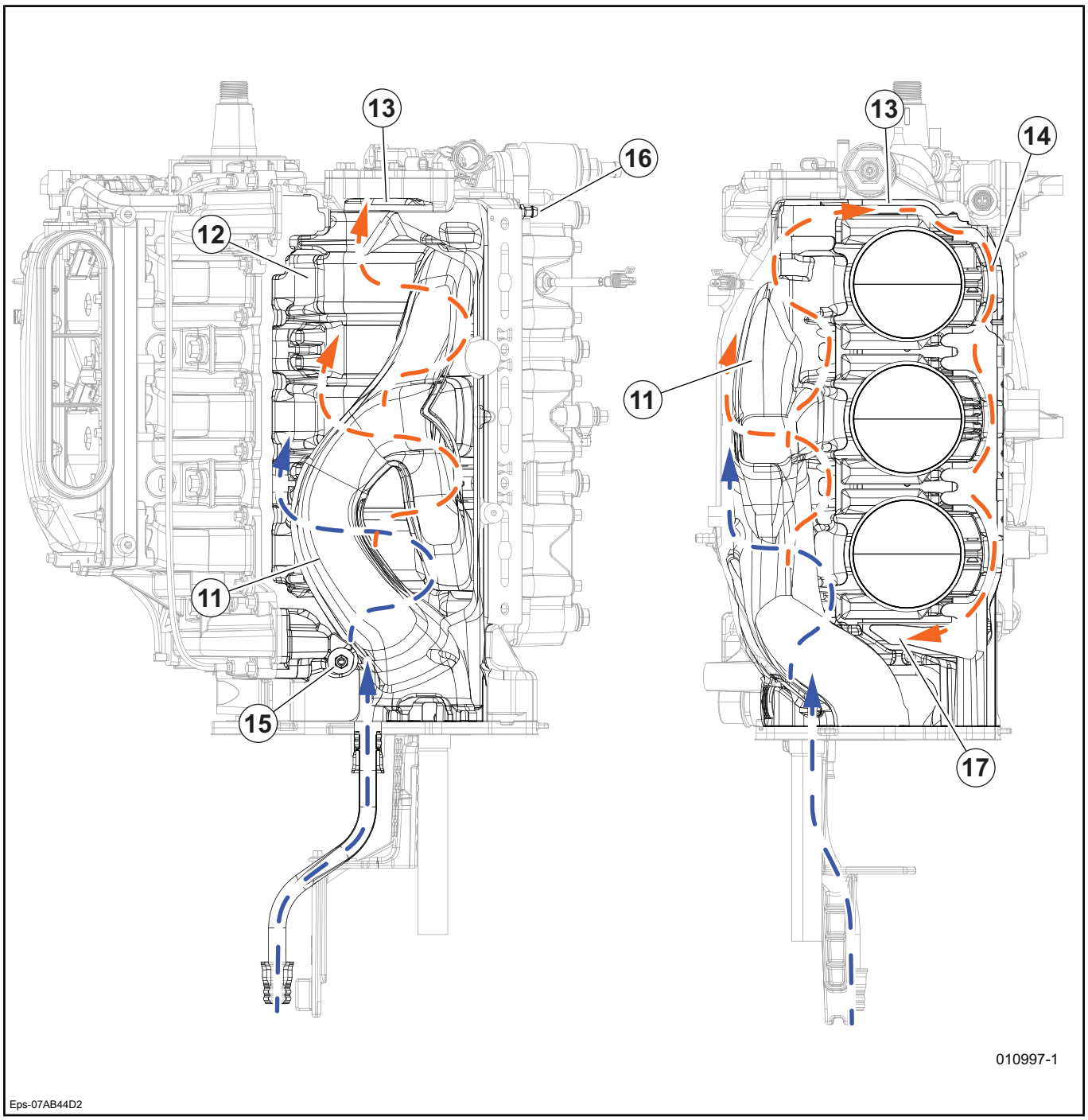
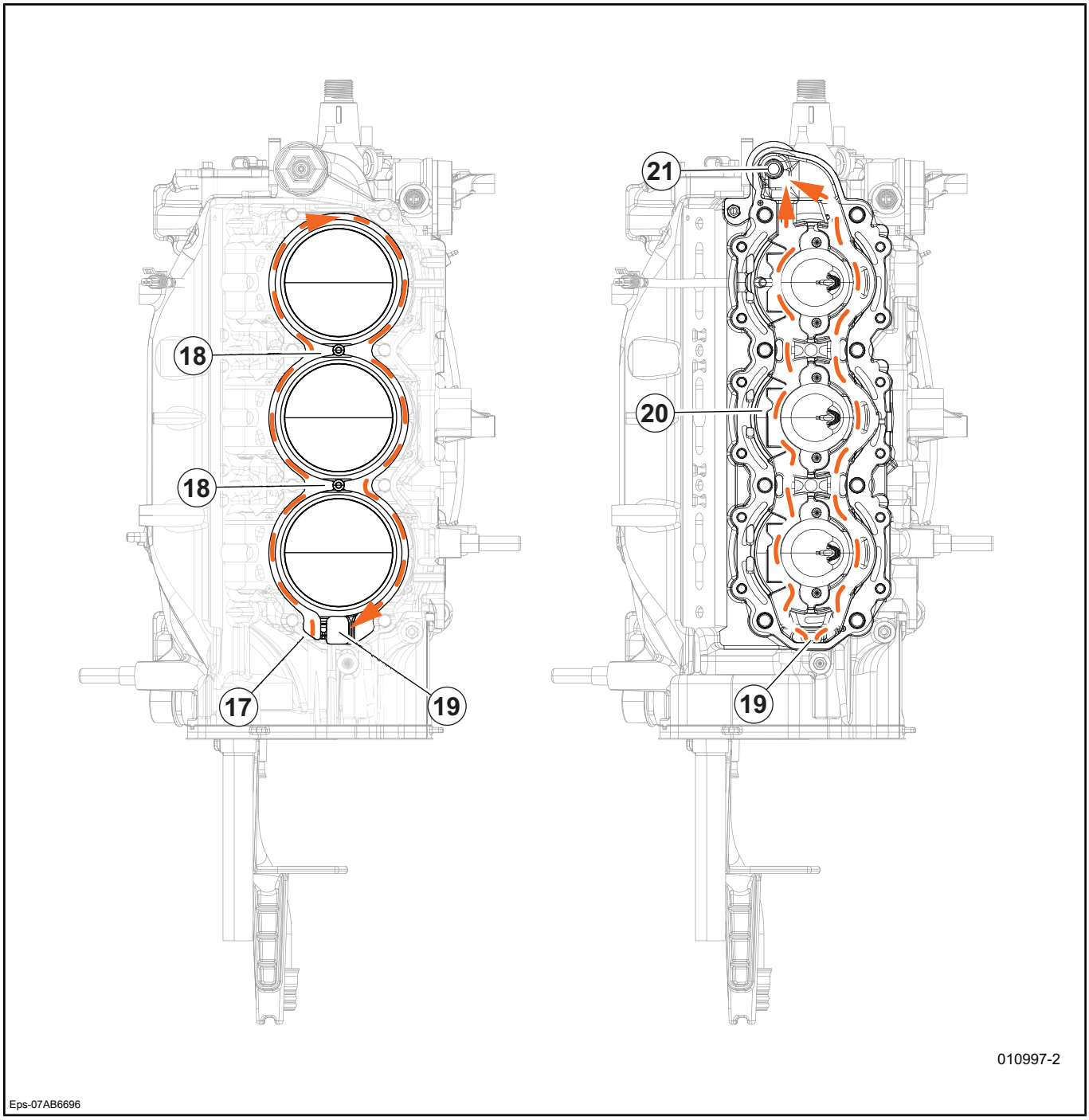
Incoming water fills the area around the exhaust runners (11) and the lower part of cylinder bore jacket (12) on the port side. Once the port side of the water jacket is filled, water flows through a cast passage (13) to fill the lower part of cylinder bore jacket (14) on the starboard side.

Cooling water is supplied to the fuel vapor separator and DPS module (if equipped), from a fitting (15) near the bottom of the block. Cooling water is supplied to EMM from a fitting (16) at the top/rear of the block.



Water flow continues through a lower cast passage (17) to fill the upper part of the cylinder bore jacket. Water dams (18) control water flow up the port side of the water jacket, over the top of #1 cylinder and down the starboard side of the upper part of the cylinder bore.

Water flows from the block to the cylinder head through a common passage (19) and fills the cylinder head (20) bottom to top. Water flow through the cylinder head stops until the engine reaches operating temperature and the thermostat (21) opens. Any air in the cooling system vents through the thermostat vent.



Cooling water exits the cylinder head through the thermostat (21) or the pressure relief valve (22) depending on the block pressure condition.

– After the thermostat opens water exits the cylinder head through a hose (23) into the outlet side (24) of the water pressure relief valve water dump passage (25).

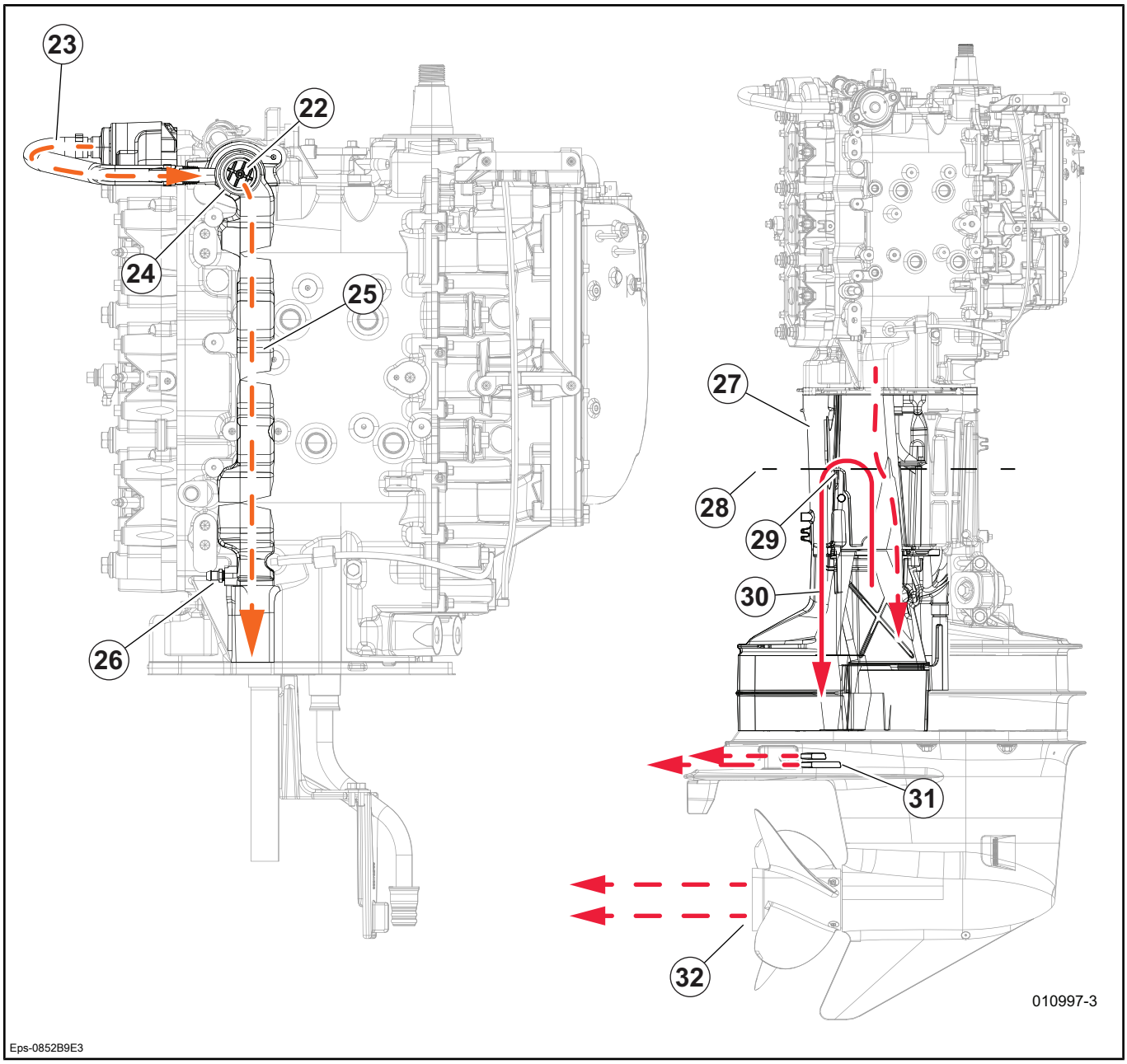
– Once the engine speed reaches 2200 to 3000 RPM the block water pressure will increase to from 17 to 22 psi and the water pressure relieve valve (22) opens and water flows out of the valve and into the water dump passage (25).

Note: If the engine load is elevated and the thermostat is fully open the water pressure relief valve opens sooner.

Cooling water from the EMM exits through a fitting (26) and the starboard rear of the block, into the water dump passage (25).

Warm water from the dump passage (25) flows into the exhaust adapter plate (8) and through the water outlet (10). Water fills the exhaust housing (27) to the level indicated (28) to cool the exhaust megaphone. Once the water level reaches cast-in dams (29) at the rear of the megaphone, the water then flows through a passage (30) at the rear of the exhaust housing and exits the engine through the water outlets (31) at the top of the gearcase. Machined drain holes (not shown) are located to drain the exhaust housing when the outboard is not in use.

Cooling water from the lower exhaust adapter (5 & 6), exits the outboard through the propeller hub (32).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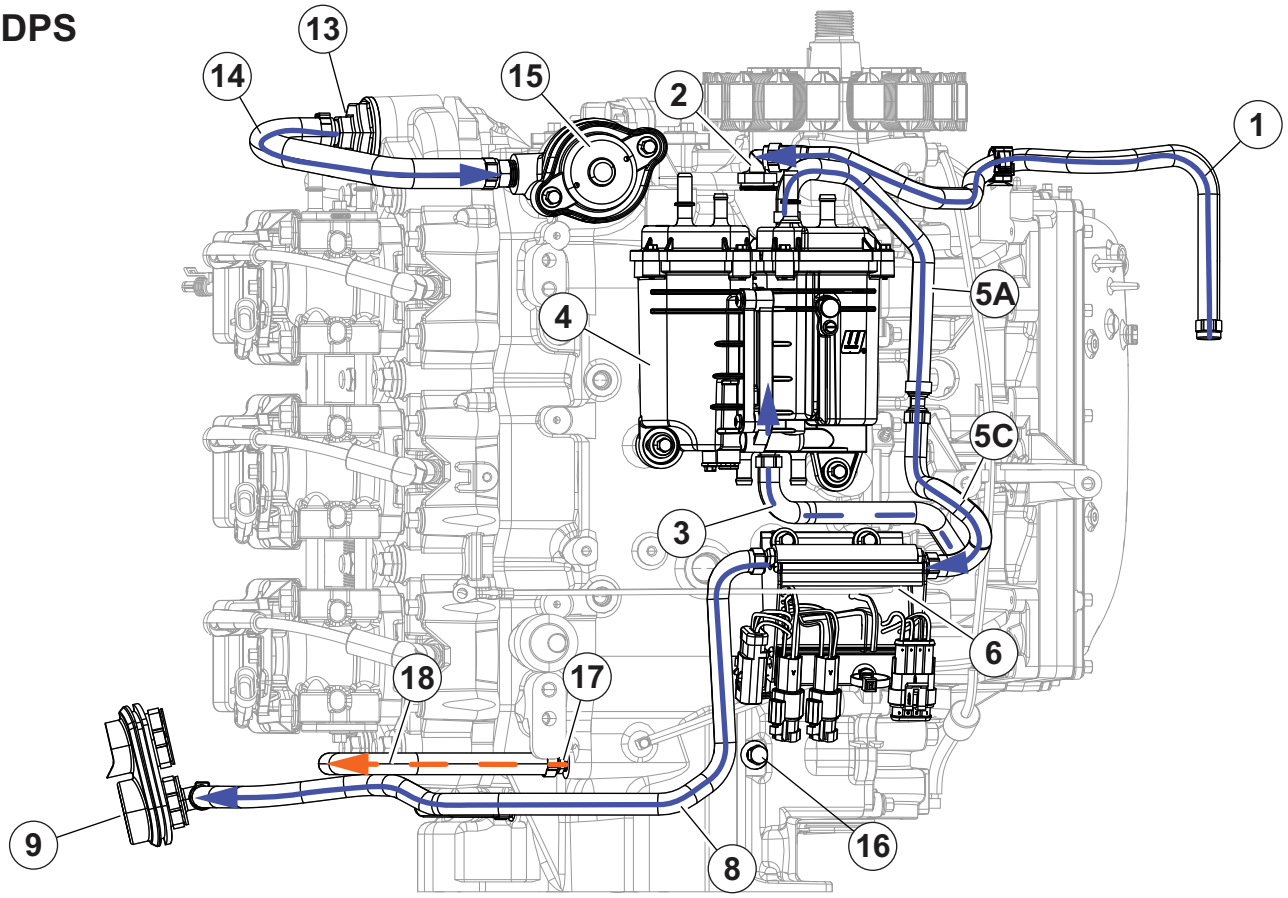
Cooling Hose Routing Diagrams

DPS



1. Flush hose
2. Flush hose fitting to block
3. Cooling water supply to VSA
4. VSA
5A. Cooling water from VSA to connector
5C. Cooling water from connector to DPS control module
6. DPS module
8. Cooling water from control module to OB indicator
9. Overboard (OB) indicator
13. Thermostat assembly
14. Cooling water from thermostat to block water out
15. Water pressure relief valve assembly
16. Accessory water pressure port
17. Exhaust pressure fitting
18. Exhaust pressure hose, fitting to EMM

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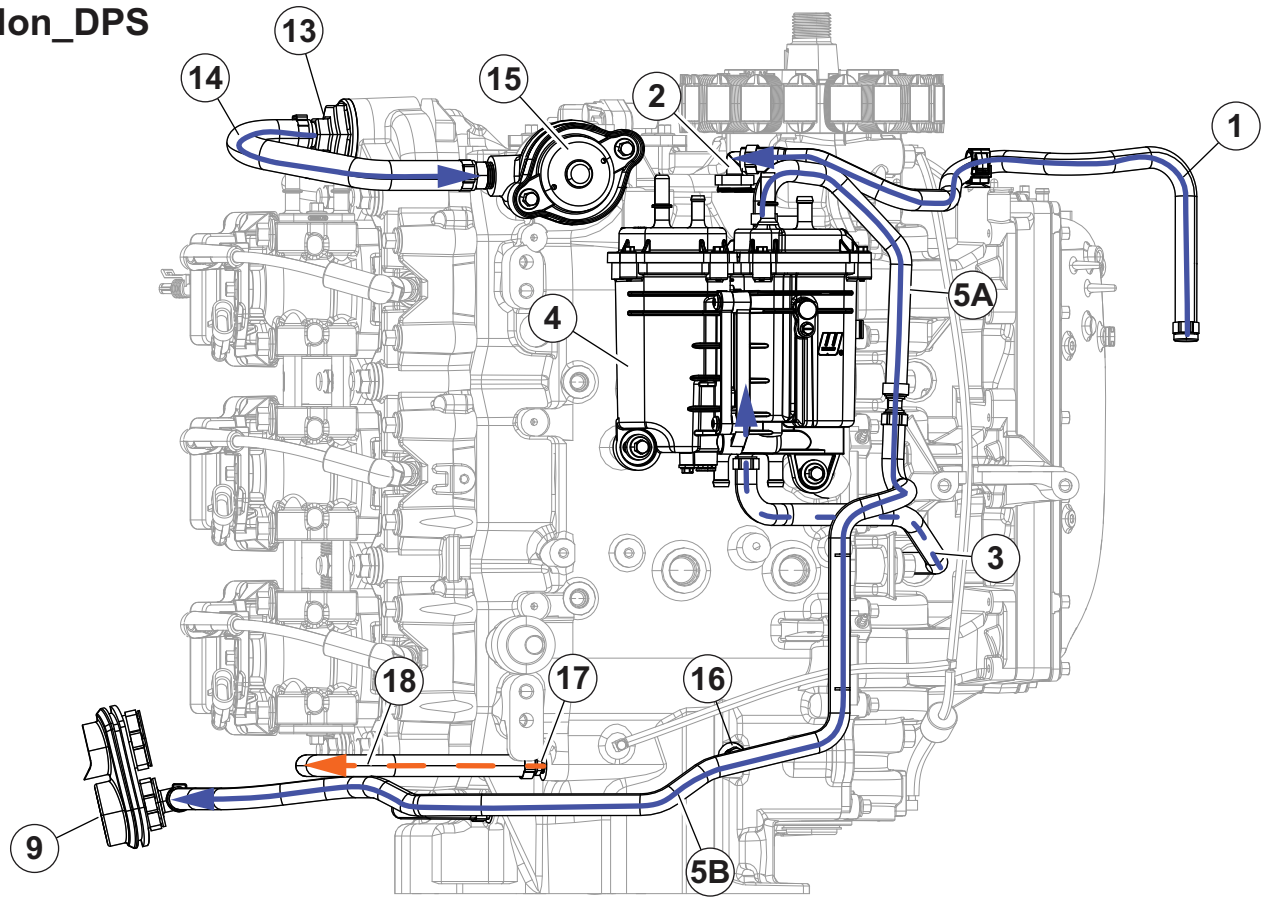
Non_DPS



1. Flush hose
2. Flush hose fitting to block
3. Cooling water supply to VSA
4. VSA

5A. Cooling water from VSA to connector

5B. Cooling water from connector to Overboard (OB) indicator

9. Overboard (OB) indicator
13. Thermostat assembly
14. Cooling water from thermostat to block water out
15. Water pressure relief valve assembly
16. Accessory water pressure port
17. Exhaust pressure fitting
18. Exhaust pressure hose, fitting to EMM

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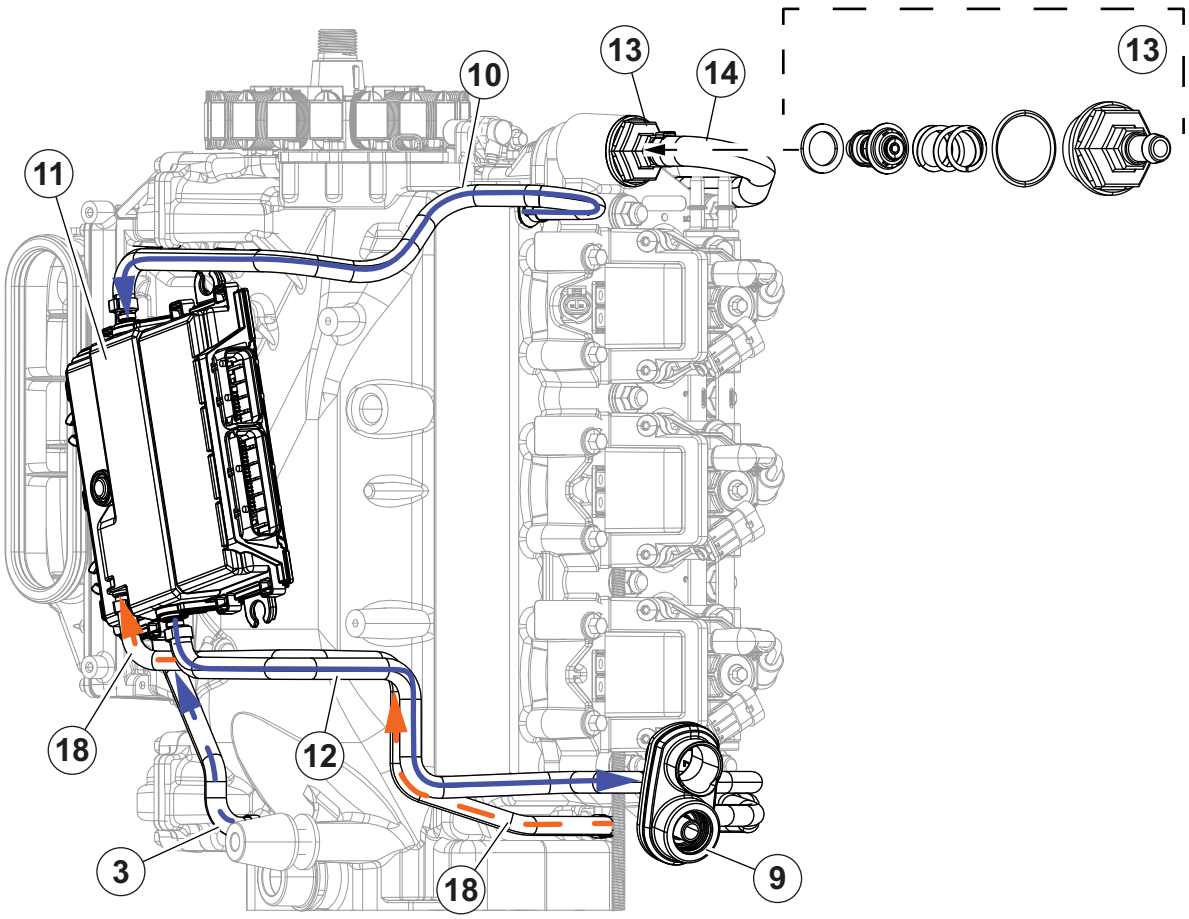

3. Cooling water supply to VSA
9. Overboard (OB) indicator
10. Cooling water supply to EMM
11. EMM
12. Cooling water from EMM to block water out
13. Thermostat assembly
14. Cooling water from thermostat to block water out
18. Exhaust pressure hose, fitting to EMM

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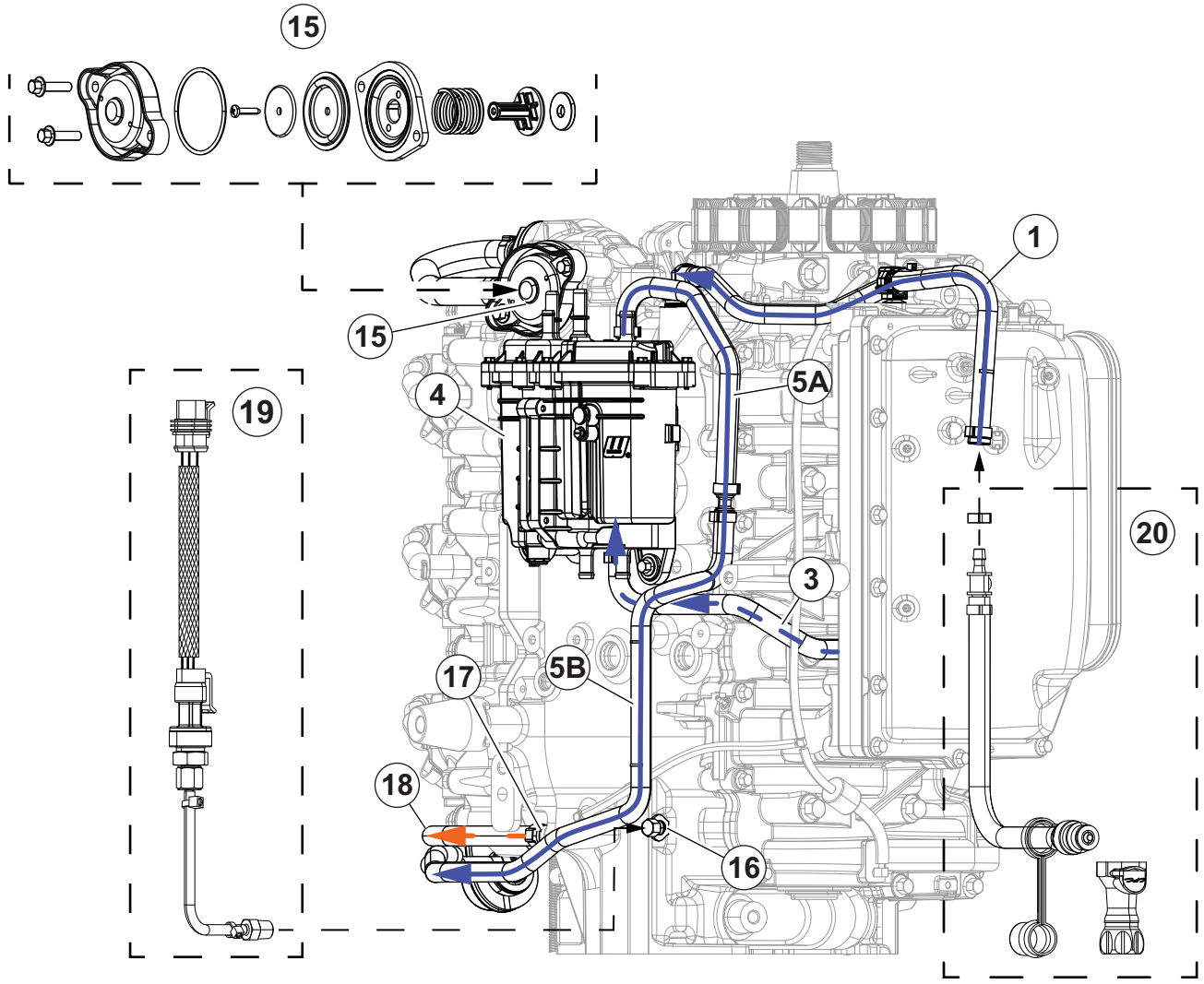

1. Flush hose
3. Cooling water supply to VSA
4. VSA
5A. Cooling water from VSA to connector
5B. Cooling water from connector to Overboard (OB) indicator (non-DPS models)
15. Water pressure relief valve assembly
16. Accessory water pressure port
17. Exhaust pressure fitting
18. Exhaust pressure hose, fitting to EMM
19. Accessory water pressure sensor
20. Accessory flushing adapter kit

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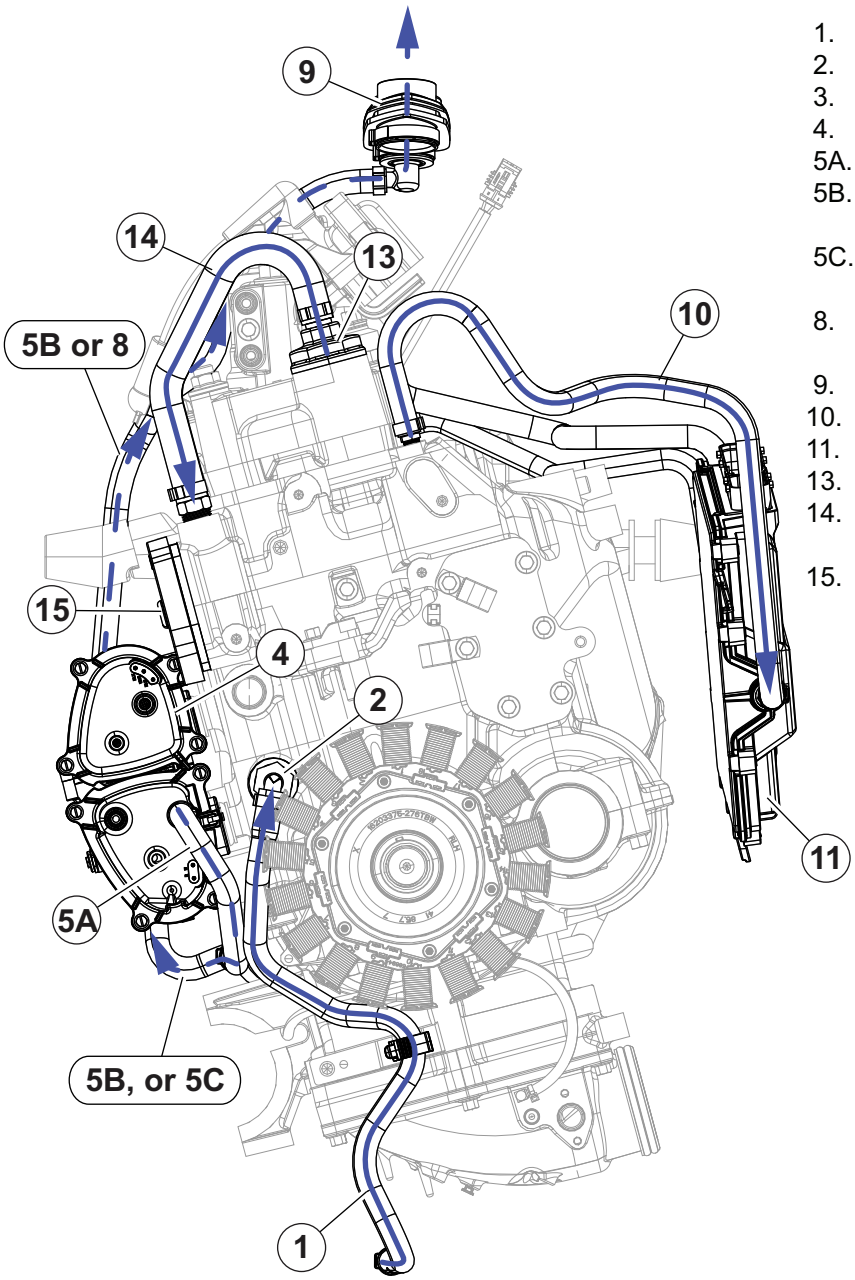

1. Flush hose
2. Flush hose fitting to block
3. Cooling water supply to VSA
4. VSA

5A. Cooling water from VSA to connector

5B. Cooling water from connector to Overboard (OB) indicator (non-DPS)

5C. Cooling water from connector to DPS control module

8. Cooling water from control module to OB indicator
9. Overboard (OB) indicator
10. Cooling water supply to EMM
11. EMM
13. Thermostat assembly
14. Cooling water from thermostat to block water out
15. Water pressure relief valve assembly

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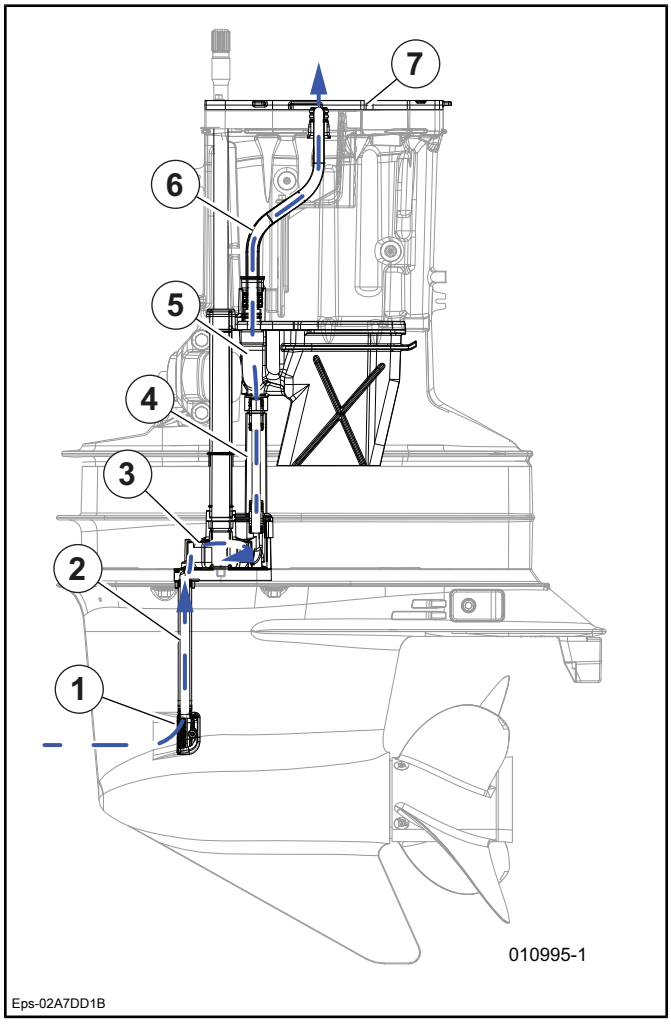
Components

Gearcase and Midsection

Cooling water enters the cooling system through water inlet screens (1) on each side of the gearcase. The water supply MUST be unrestricted and unaerated. Water flows into a water tube (2) through a manifold on the gearcase and into the water pump (3). Water is drawn into the water pump through an inlet in the water pump plate. All cooling water to the powerhead is provided by the water pump.

The water pump outlet connects with a water tube assembly (4). Grommets seal the water tube to the water pump housing and to a lower exhaust adapter (5) located in the outboard's midsection.

Grommets seal a second water tube assembly (6) which connects the lower exhaust adapter to the exhaust adapter plate (7).

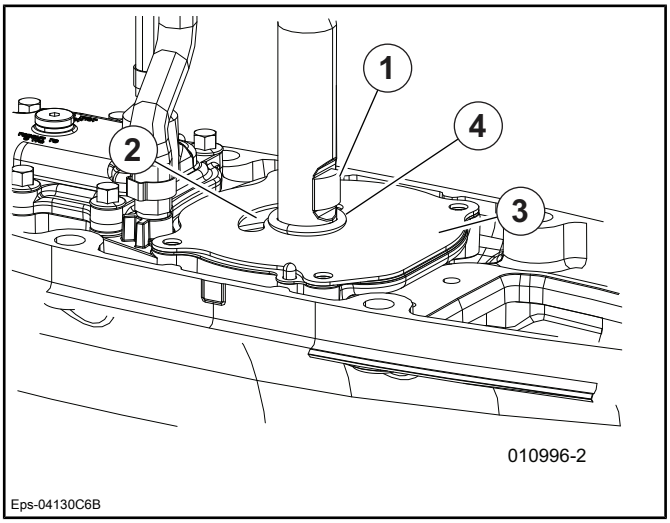


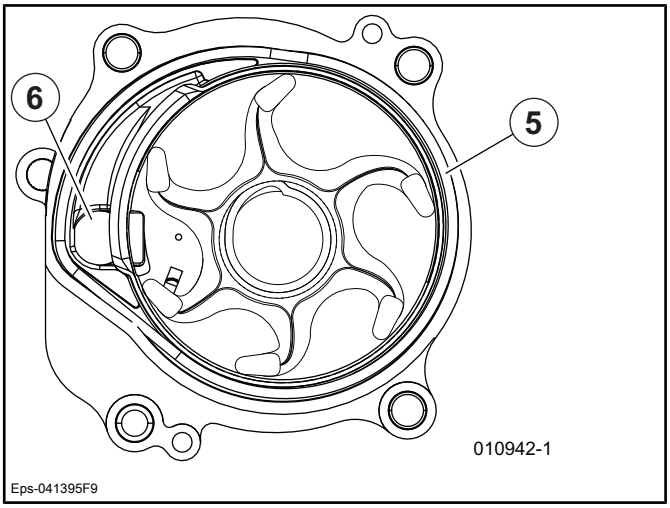
Water Pump

The pump operates as a positive displacement pump at LOW speeds (below 1500 RPM) and as a centrifugal pump at HIGHER speeds. Water pump operation requires the impeller key which is a nylon wedge, to engage the impeller bushing and drive shaft. In order for cooling water to be drawn in the water pump inlet:

– The water pump plate MUST seal to gearcase.
– The impeller MUST seal to the water pump plate.
– The impeller housing and liner must seal against the water pump plate.

Refer to **Water Pump Service** for water pump servicing.



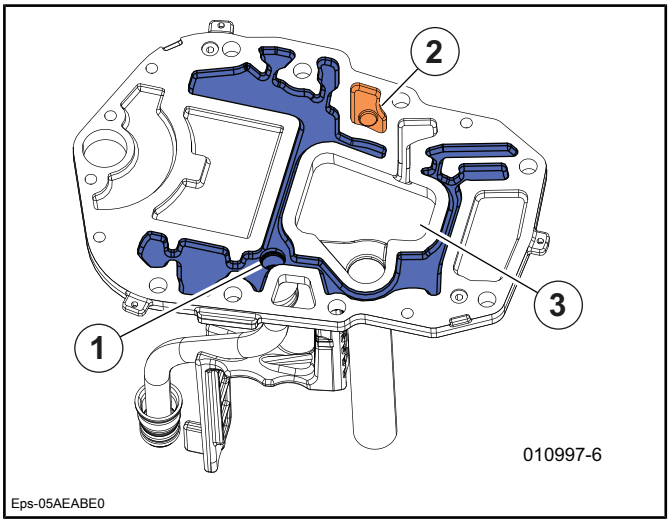


1. *Impeller key*
2. *Water pump inlet*
3. *water pump plate*
4. *Impeller sealing o-ring*
5. *Impeller housing seal*
6. *water pump outlet*

Exhaust Adapter Plate

The exhaust adapter plate:

– Adapts the cylinder/crankcase assembly (powerhead) to the exhaust housing and the water tube.
– Provides a water inlet and outlet which route incoming and outgoing cooling water.
– Provides exhaust passages which connect to the gearcase.



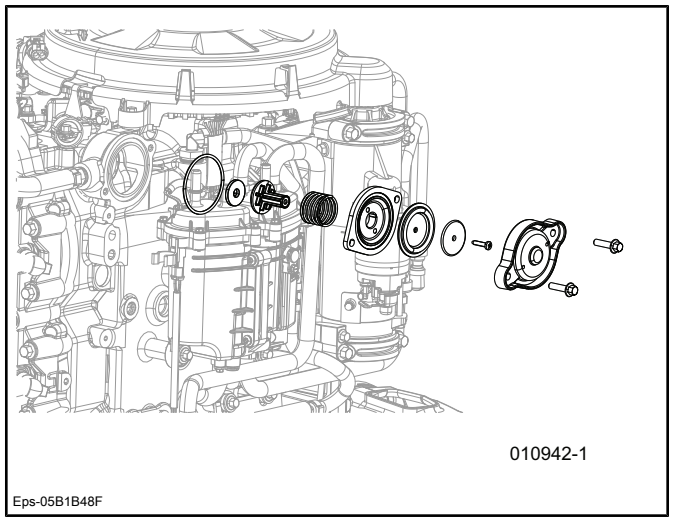
1. *Water inlet*
2. *Water outlet*
3. *Exhaust passage*

Pressure Relief Valve

A pressure relief valve is used to control water flow and operating temperature at higher speeds (above approximately 2200 to 3000 RPM). The pressure relief valve opens as water pressure increases. Spring tension sets the opening pressure.

Overheating: A restricted or faulty valve typically results in HIGH SPEED overheating.

Overcooling: Debris may prevent the valve from closing completely.

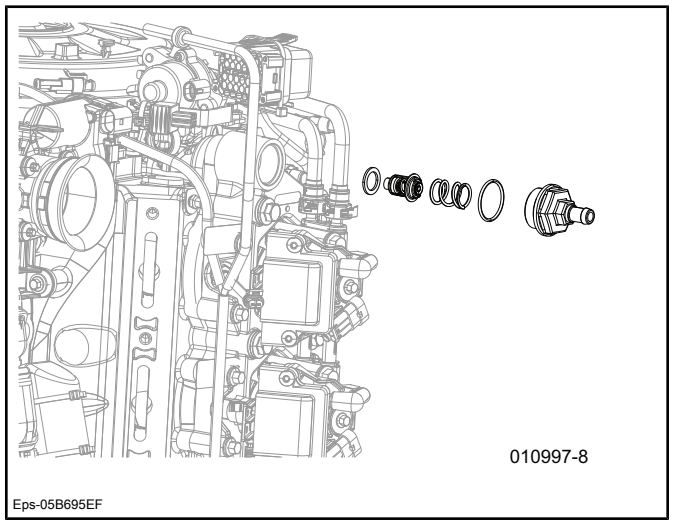


Thermostat

A thermostat controls water flow and operating temperature at lower speeds (below 2500 RPM).

Overheating: A restricted or faulty thermostat typically results in LOW SPEED overheating.

Overcooling: Debris may prevent the thermostat from closing completely.



Operation

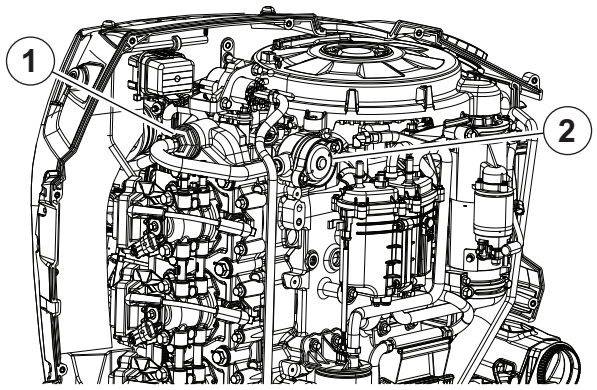
All models use a two-stage cooling system design. The cooling system is dependent on water pump pressure and controlled by thermostat and pressure valve operation.

NOTICE

Restricted or inadequate water flow through the outboard reduces cooling system performance and may lead to severe powerhead damage.

Cylinder Block / Cylinder Head Cooling

The flow of water through the cooling system is controlled by a thermostat and a pressure valve.



1. *Thermostat*
2. *Pressure relief valve*

The thermostat and pressure valve control the flow of water leaving the water passages of the cylinder head and block.

Low speed Operation: The pressure relief valve is closed and the thermostat regulates water to flow to maintain a temperature of approximately 143°F (62°C).

After the thermostat opens, water exits the cylinder head through a hose into the outlet side of the water pressure relief valve water dump passage .

Higher speed Operation: Once the engine speed reaches 2200 to 3000 RPM the block water pressure will increase to from 17 to 22 psi and the water pressure relieve valve opens. Water flows out of the valve and into the water dump passage.

NOTE: If the engine load is elevated and the thermostat is fully open the water pressure relief valve opens sooner.

Water from the dump passage flows through the exhaust adapter plate into exhaust housing and exits the engine through the water outlets at the top of the gearcase.

This pressure controlled water outlet circuit provides a high flow rate of discharge water during high speed operation.

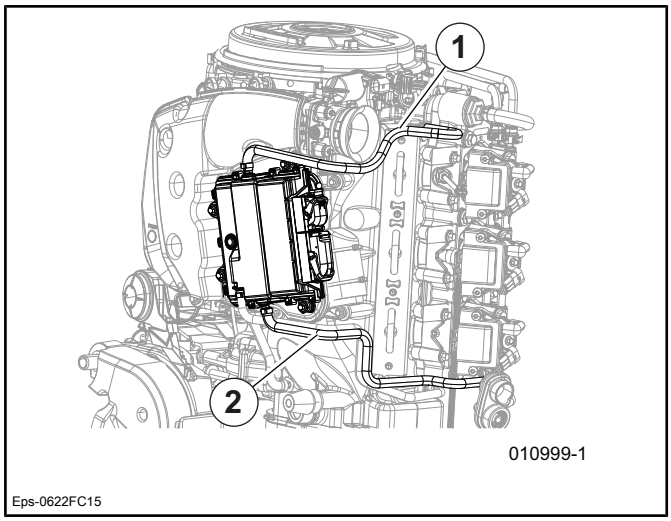
EMM Cooling

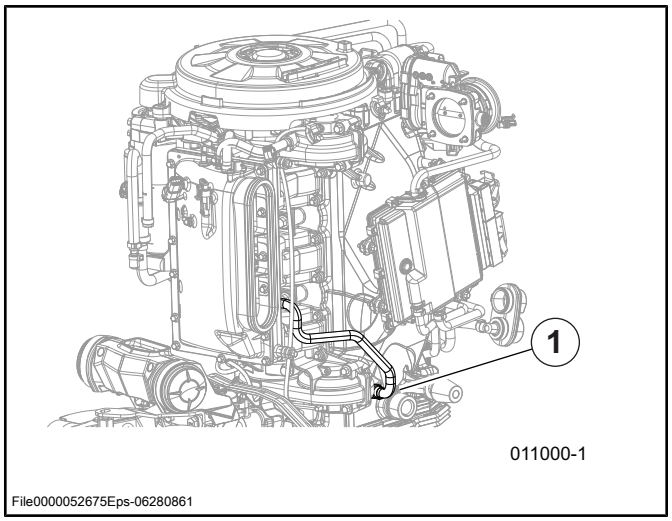
IMPORTANT: Improper *EMM* cooling will activate fault codes 25 and 29 and the Engine Monitor warning system. Refer to the **EMM Fault Code Chart** at the back of this manual for specific fault code information.

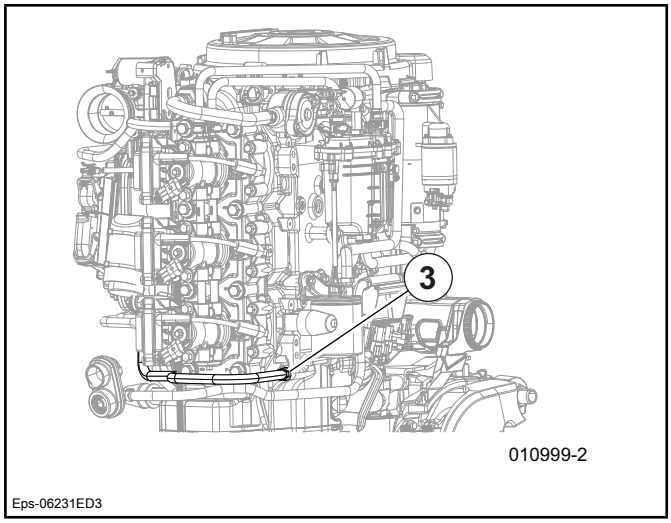
Cooling of the *EMM* helps to stabilize the temperatures of internal components.

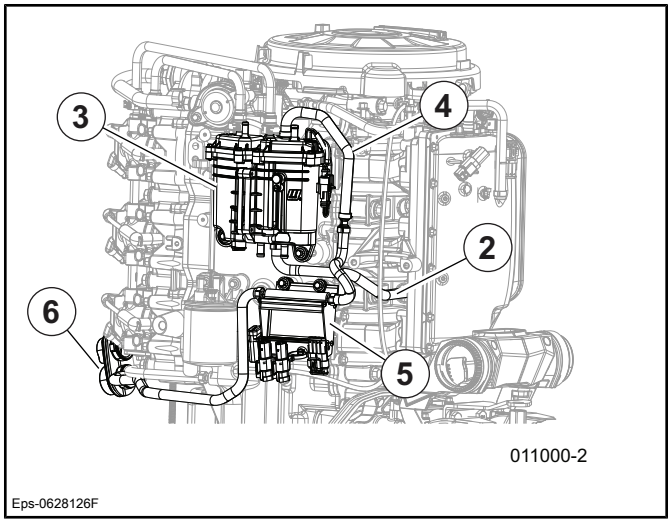
Cooling water is routed from a fitting at the top of the cylinder block through an inlet hose to the *EMM* water cavity. Cooling water from the *EMM* exits through an outlet hose, into a fitting at the starboard/ rear of the block, into the water dump passage.

Water from the dump passage flows through the exhaust adapter plate into exhaust housing and exits the engine through the water outlets at the top of the gearcase.









1. *Inlet hose*
2. *Outlet hose*
3. *Fitting to water dump passage*

1. *Fitting, bottom/ port*
2. *Water supply hose to the vapor separator*
3. *Vapor separator*
4. *Hose and connector assembly*
5. *DPS module*
6. *Overboard indicator*

Vapor Separator Cooling

Cooling the vapor separator fuel chamber minimizes fuel vaporization. Also see **Fuel System Flow Diagram**, for additional details of vapor separator cooling.

Cooling water is supplied to the fuel vapor separator and DPS module (if equipped), from a fitting near the bottom/ port side of the block. Cooling water routed through a hose to the water inlet fitting at the bottom of the vapor separator water cavity.

Cooling water exits the vapor separator from the top through a hose and connector assembly to the DPS module (if equipped).

Water exits the engine from the overboard indicator.

Engine Temperature Check

IMPORTANT: The engine temperatures listed in this section are based on an intake water temperature of 70° ± 10°F (21° ± 3°C).

Install correct test propeller and place outboard in a test tank or in the water. Start outboard and run at 3000 RPM in FORWARD gear for at least five minutes. Remember, running outboards at high speeds in test tanks may disrupt water flow to gearcase water intakes. Make sure the outboard has adequate water flow.

⚠ CAUTION

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

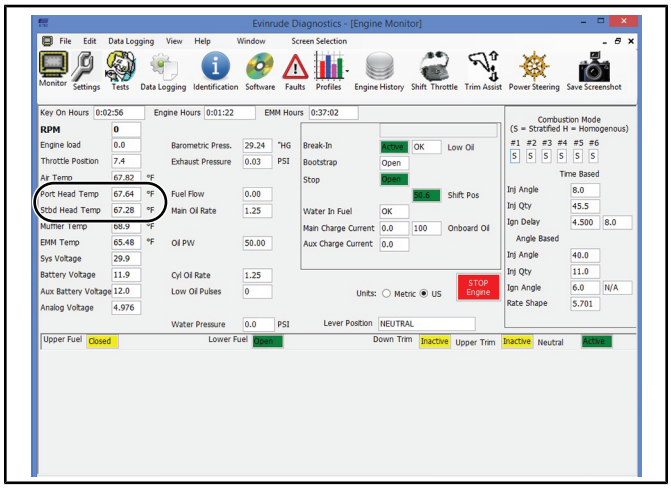
Reduce speed to IDLE for five minutes. Check IDLE operating temperature.

Increase speed to 5000 RPM and check temperature.

If engine temperature is not within range, troubleshoot cooling system.

Software Method

Use the *Monitor* screen of *Evinrude Diagnostics* software v 6.4 or higher, to read temperature displays.



ENGINE MONITOR SCREEN

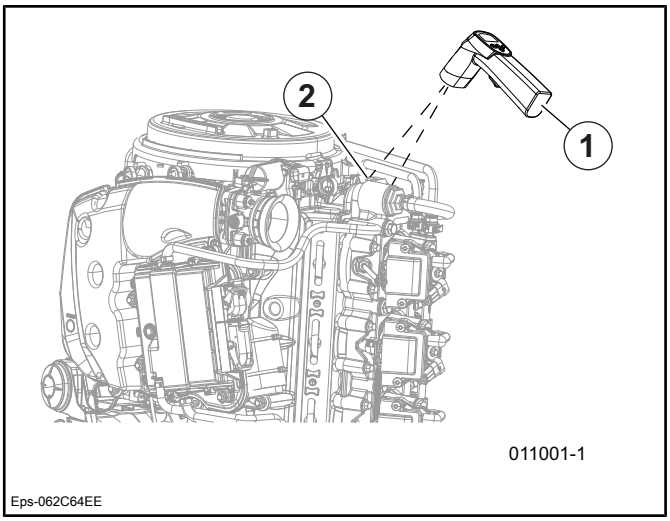
Typical temperature displays at IDLE speed should be 140°F ± 10°F (60°C ± 6°C)

Typical temperature displays at WOT speed should be 150°F ± 10°F (66°C ± 6°C)

Operating temperature must not exceed TBD ° F (TBD°C).

Pyrometer Method

1. Use an infrared thermometer such as Raytek MT4U MiniTemp or a digital pyrometer to measure the outboard's operating temperatures.
2. Measure temperature at the top of cylinder block, next to the thermostat housing and cylinder head.



1. *Infrared thermometer*
2. *Measure temperature in this area*

NOTE: Typical pyrometer readings at IDLE speed should be 140°F ± 10°F (60°C ± 6°C).

IMPORTANT: If you get low or inaccurate readings with a digital pyrometer, coat the probe location with *Thermal Joint Compound*, P/N 322170.

Cooling System Troubleshooting

Idle Operating Temperature — Below Range

Problem and Observations

Problem Statement:

Engine is difficult to start, idles poorly.

Observations:

1. Spark plugs are fouled
2. *Evinrude Diagnostics* software reveals engine IDLE temperature is below operating range 140°F ± 10°F (60°C ± 6°C).

Solution

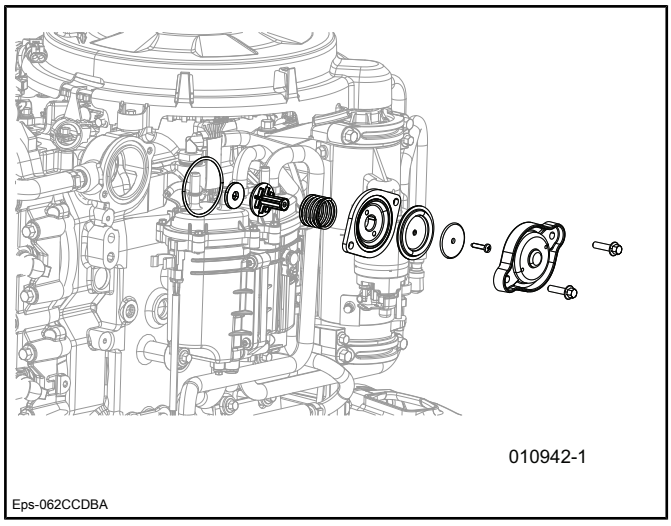
Check thermostat and pressure relief valve operation.

Pressure Relief Valve

The pressure relief valve should be closed at IDLE speed. Water should not flow past the plunger and the sealing surface in the exhaust adapter.

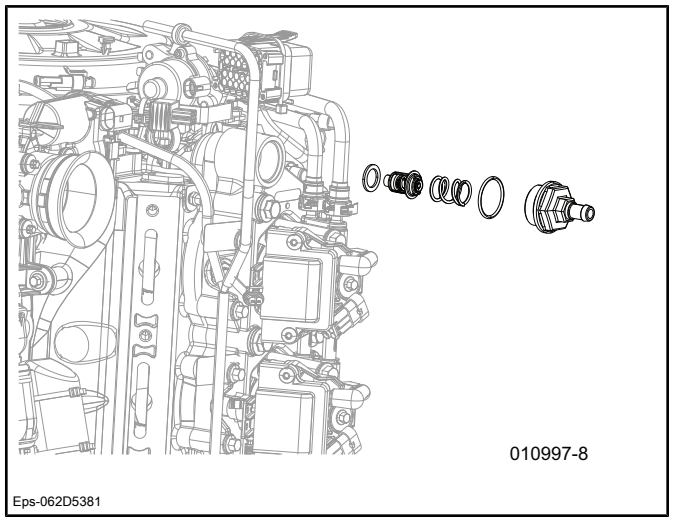
Start the outboard and check IDLE operating temperature using *Evinrude Diagnostics* software, v 6.4 or higher.

If IDLE temperature is below operating range, remove and inspect the pressure relief valve. Refer to **Pressure Relief Valve** in the **Component Servicing** section.

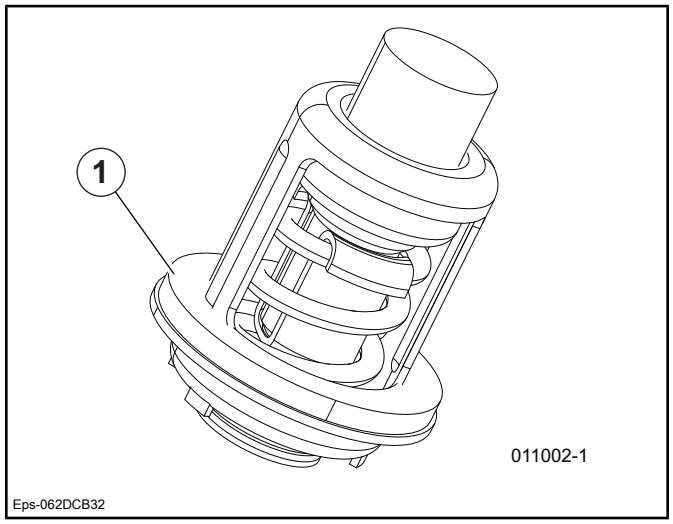


Thermostats

Remove the thermostat cover and inspect the thermostat.



Check position of thermostat seal and how thermostat seals against cylinder head. Seal must be properly fitted to flange of thermostat.



1. Seal fitted to flange of thermostat

Check thermostat for cracks, heat damage, or signs of corrosion. Check for proper operation. Thermostat opens at 143°F (62°C).

9

Loss of Performance After Severe Engine Overheat

Problem and Observations

Problem Statement:

Loss of performance occurring AFTER a severe engine overheat.

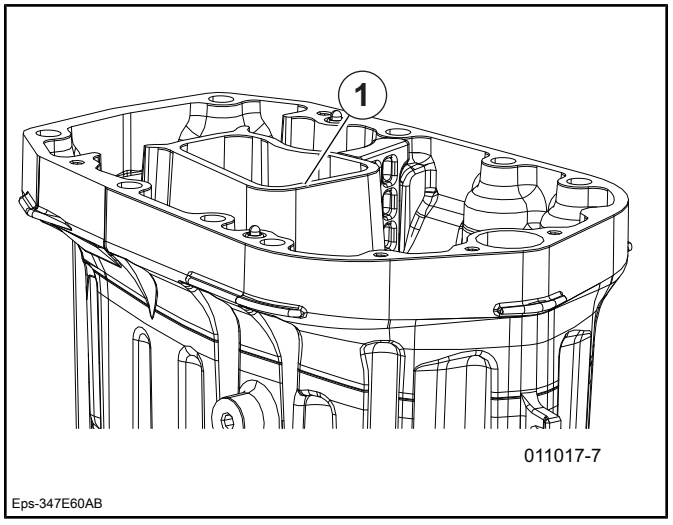
Observations:

1. Water pump was completely destroyed, had to be replaced.
2. Boat very difficult to plane.
3. Engine low top end power.

Solution

Lift the powerhead from midsection. Refer to **Powerhead Removal**. Then perform the following:

1. Remove adapter from exhaust housing. Refer to **Exhaust Adapter Plate Removal**.
2. Inspect the top surface of the megaphone for signs of melted material.



1. Top surface of megaphone

   If the top surface of the megaphone surface is melted, replace the exhaust housing.
3. Install a new exhaust housing to adapter gasket and install adapter. Refer to **Exhaust Adapter Installation**.
4. Install new adapter to powerhead gasket and install powerhead. Refer to **Powerhead Installation**.

Component Servicing

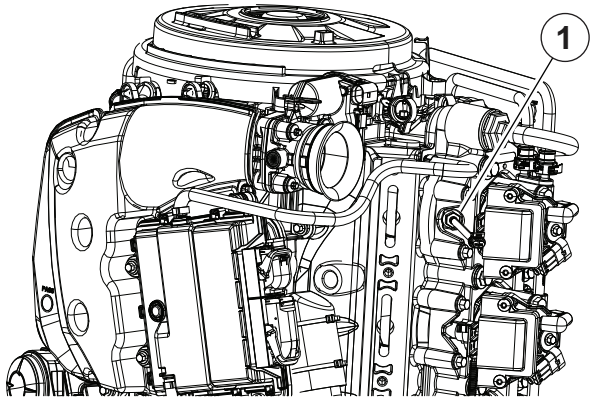
SERVICE PRODUCTS

Description	Part Number	Page
THERMAL JOINT COMPOUND	P/N 322170	213
TRIPLE GUARD GREASE	P/N 508298	214

Temperature Sensor Removal

1. Loosen sensor and remove by hand.

NOTE: Use care to avoid breaking threads.



1. Temperature Sensor

2. Clean sensor threads, sensor, and sensor cavity.

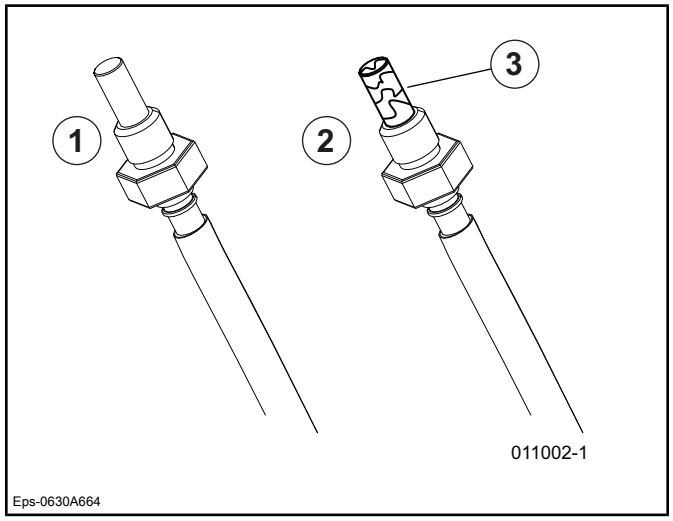
Temperature Sensor Installation

1. Apply a small amount of Thermal Joint Compound, P/N 322170, into the bottom of the sensor cavity.

Required Chemical
Thermal Joint Compound
P/N 322170

2. Install the sensor hand tight.
3. Remove the sensor and check thermal joint compound coverage on the sensor probe.

NOTE: Thermal joint compound should cover at least 75% of the length to the sensor probe.



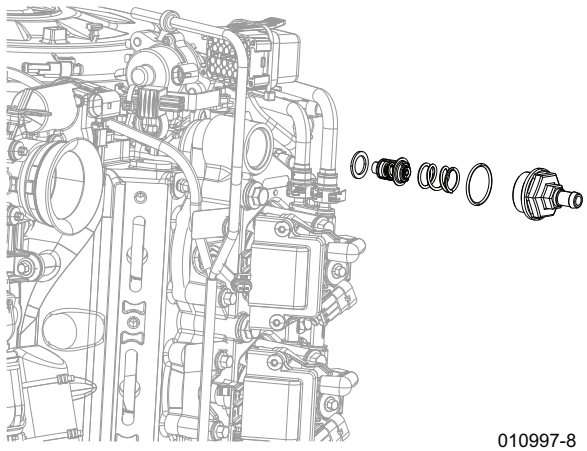
1. Temperature sensor
2. Temperature sensor with thermal joint compound
3. Thermal joint compound

4. SLOWLY tighten temperature sensor to a torque of 12 to 18 in. lbs. (1.35 to 2.0 N·m).
5. Wait 10 minutes for trapped air to bleed from cavity and then re-tighten.

NOTE: Thermal compound may seep past threads.

Thermostat Removal

1. Remove the thermostat cover and O-ring from cylinder head.
2. Remove spring, thermostat, and gasket.



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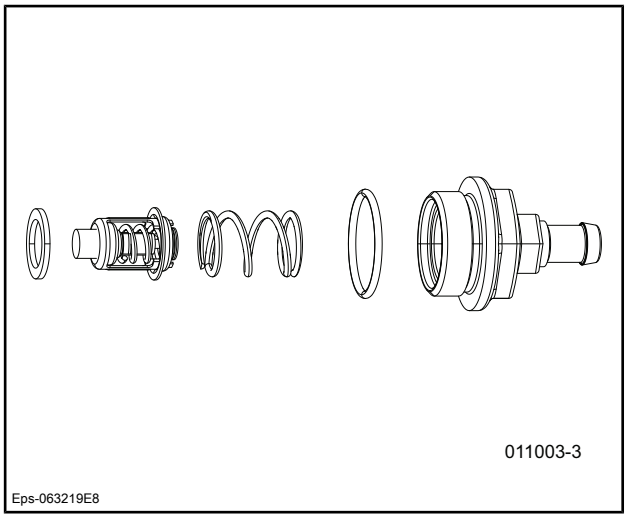
Thermostat Inspection

1. Inspect all parts for cracks, heat damage, or signs of corrosion.
2. Replace damaged parts.
3. Clean debris from housing and parts.



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Thermostat Installation

Installation is the reverse of removal. Pay close attention when performing the following additional tasks.

1. Coat threads of the cylinder head thermostat cover with *Triple Guard* grease.

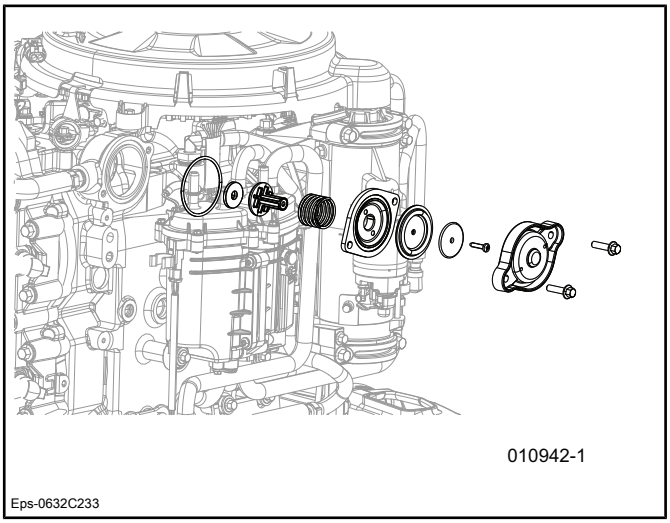
Required Chemical
Triple Guard grease **P/N 508298**

2. Install and tighten the cover to a torque of 120 to 144 in. lbs.(13.5 to 16.5 N·m).
3. Reinstall hose on the fitting of the thermostat cover with a new *Oetiker* clamp.

Pressure Relief Valve Removal

The pressure relief valve assembly should be serviced at the same time as the thermostats.

1. Remove the screws securing the pressure valve cover to the cylinder block.
2. Remove the pressure valve cover, pressure valve assembly and O-ring from the block.



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Pressure Relief Valve Inspection

1. Inspect all parts for cracks, heat damage, or signs of corrosion.
2. Replace damaged parts.
3. Clean debris from cylinder block and other parts.

Pressure Relief Valve Installation

Installation is the reverse of removal. Pay close attention when performing the following additional tasks.

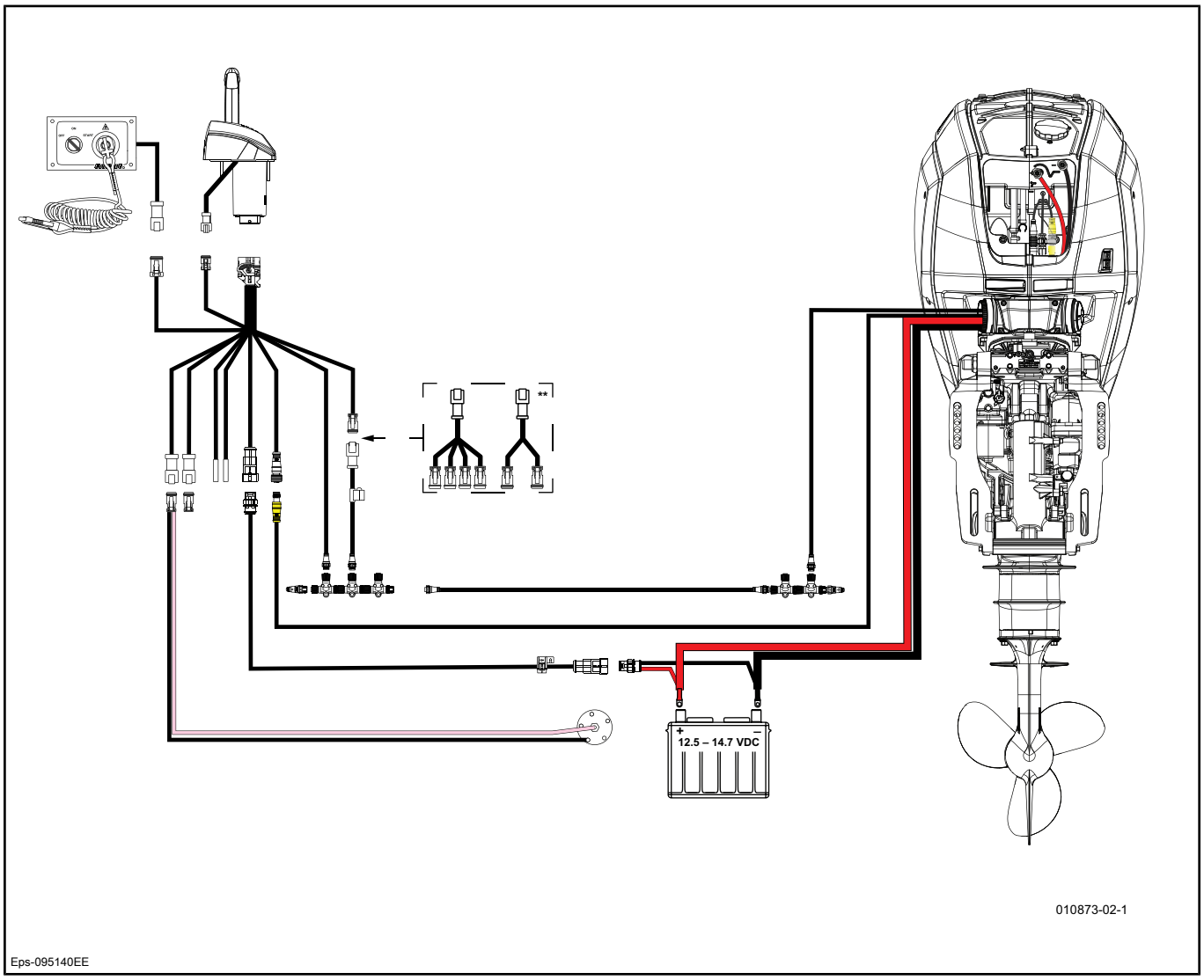
1. Install pressure valve assembly into the cylinder block.
2. Install cover with two screws.
3. Tighten screws to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).

Evinrude ICON II Remote Control System

Components

The *ICON II* remote control system includes the following components:

- *ICON II* remote control(s)
- Remote control (private) network
- *NMEA 2000* (public) network
- Up to two *Evinrude E-TEC G2* inline 3–cylinder outboards



ICON II Remote Control

ICON II remote controls are electronic shift and throttle remote control systems which manage all engine control functions through a low-voltage, digital data network.

Sensor inputs and internal *EMM* controllers are used to control the operation of the outboard's shift and throttle functions.

Use *Evinrude Diagnostics* software to troubleshoot the sensors. Refer to the **Fault Code Chart** at the back of this service manual for the complete list of all control system fault codes.

ICON II remote controls are available in basic and premium versions in the following configurations:

– Single Lever Binnacle Mount, use in single outboard, single or dual station installations
– Side Mount, use in single outboard installations.
– Concealed Side Mount, use in single outboard installations. May be used with an optional accessory foot throttle.
– Dual Lever Binnacle Mount, use in multiple outboard (up to 2 Inline 3–cylinder models, or up to 4 V6 models), single or dual station installations.

Remote Control (Private) Network

Shift and throttle information is transmitted and received between the *EMM* and *ICON II* remote control system via a dedicated Controller Area Network (CANbus), known as the remote control network, or private network.

The remote control network is powered directly from the battery. The network may include backbone buss cables, backbone extension cables, one or more 6-port hubs, or accessories. Refer to the current ***Evinrude E-TEC G2 Installation and Predelivery Guide***.

NMEA 2000 (Public) Network

For safety, the remote control data is also shared on a *NMEA 2000* network as backup.

Outboard *EMM*

The *EMM* receives shift, throttle and other control information from the *ICON II* remote control.

Shift and throttle controllers internal to the *EMM* activate the shift actuator and the electronic throttle body assembly to the positions commanded by the remote control. Also see **Electronic Shift Controller** and **Electronic Throttle Controller**.

If the *ICON II* remote control cannot communicate with the *EMM*, all remote control LED indicators flash until control levers and shift actuators are in NEUTRAL.

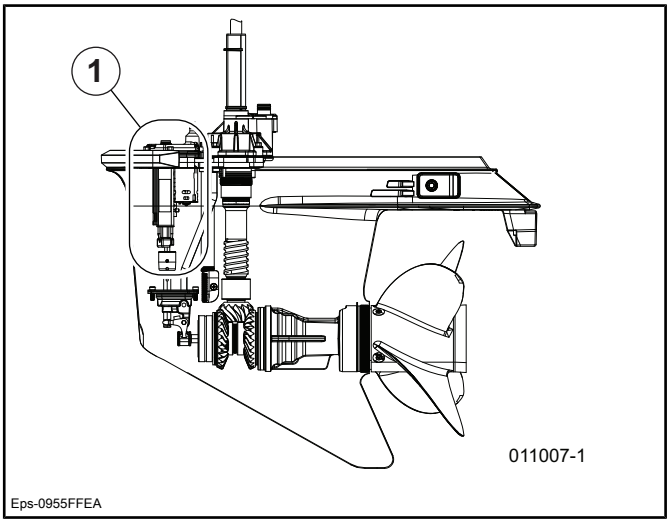
Then, the NEUTRAL indicator LED for the outboard that has a fault flashes. The *EMM*:

– Activates NEUTRAL idle mode
– Stores remote control fault codes: 21, 24, 27, or 30.

Shift Actuator Assembly

The shift actuator converts electronic signals from the Electronic Shift Controller (ESC) in the EMM into the mechanical motion required to shift the outboard into and out of gear.

Also see **Shift Actuator**.



1. Shift Actuator

If the shift actuator cannot achieve the commanded gear, the FORWARD, NEUTRAL or REVERSE indicator LED flashes to indicate which gear position is affected. The *EMM*:

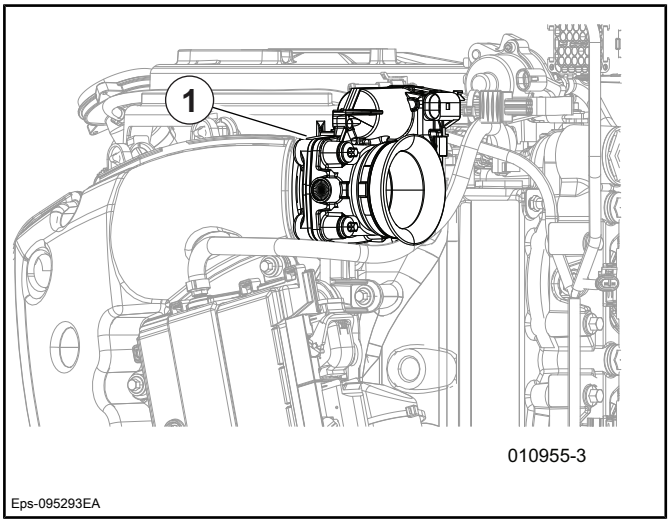
– Activates *S.A.F.E.*
– Stores *EMM* fault code 240
– Engine Monitor: CHECK ENGINE display ON

Throttle Valve Assembly

The electronic throttle body assembly converts electronic signals sent from the Electronic Throttle

Controller (ETC) in the *EMM* into the mechanical motion required to move the throttle plate.

Also see **Electronic Throttle Controller**.



1. Electronic throttle body

If the ETC cannot communicate with the electronic throttle body for more than 250 milliseconds, the *EMM*:

- Activates *S.A.F.E.*
- Stores *EMM* fault code 162
- Engine Monitor: CHECK ENGINE display ON

If the throttle plate cannot achieve the commanded position, the *EMM*:

- Activates *S.A.F.E.*
- Stores *EMM* fault code 179
- Engine Monitor: CHECK ENGINE display ON

System Settings and Diagnostics

Use *Evinrude Diagnostic* software, v 6.4 or higher to communicate with the remote control. Refer to **Communication**.

Diagnostic software can change configuration settings, view identification information and stored faults, monitor control functions or update software.

Multiple Engine Instancing

Multiple outboard installations require the transom position of each outboard be identified.

Engine identity is set and stored in the *EMM* of each outboard. By default the *EMM* of all outboards is set to instance zero (0) at the factory. Outboards are identified as Instance 0 through 3, from port to starboard, up to four outboards.

Engine identity of each outboard must be set manually or with *Evinrude Diagnostics* software v 6.4 or higher. Use the following chart to assign the engine instance number to the outboard's position on the transom.

Identity Numbers Chart

Number of Outboards	Transom Position				
	Port	Port Center	Center	Starboard Center	Starboard
1	0				
2	0				1
3 (V6 Models Only)	0		1		2
4 (V6 Models Only)	0	1		2	3

If duplicate engine identity numbers are detected, the affected outboard's NEUTRAL indicator LED will flash rapidly.

Manual Instancing Method

⚠ WARNING

Do NOT vary from this procedure.
Pressing any other button on the remote control or switch panels other than the STOP switch or turning the key OFF will exit from this process.
This can cause the system to react unpredictably. If any other button is pressed accidentally, turn the key switch OFF and start the procedure over.

When manually setting engine instance, start with the port outboard and work toward the starboard outboard. Follow these steps EXACTLY:

1. With the key switch off, disconnect the remote control (private) network cables from all outboards.
2. Push and hold the SYNC button while turning the key switch ON. Continue holding the SYNC button for at least 2 seconds.
3. Connect the remote control (private) network cable to the first (port) outboard, powering the *EMM*. Then press the STOP button for that outboard. The control will send an instance message with appropriate instance to the *EMM*.
4. After setting the instance on outboard #1, disconnect the private network cable from outboard #1. Connect the private network cable to outboard #2. Then press the STOP button for outboard #2.

   If this installation has more than two outboards, go to the step 5. If this is a dual outboard installation, go to step 7.
5. After setting the instance on outboard #2, disconnect the private network cable from outboard #2. Connect the private network cable to outboard #3. Then press the STOP button for outboard #3.

   If this installation has more than three outboards go to the step 6. If this is a triple outboard installation, go to step 7.
6. After setting the instance on outboard #3, disconnect the private network cable from outboard #3. Connect the private network cable to outboard #4. Then press the STOP button for outboard #4.
7. After setting the instance on the last outboard, turn the key switch OFF. Connect the private network cable to all outboards. Then turn the

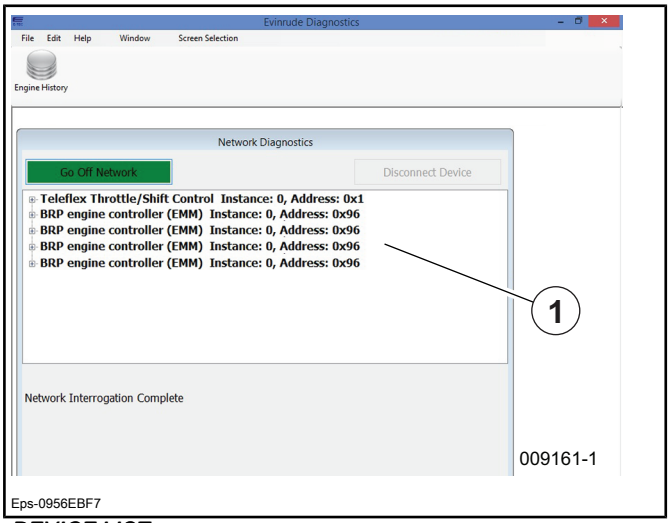
key switch ON to complete the instancing process.

Diagnostic Software Method

Before beginning, record the model number and serial number from the serial number tag of each outboard. Note the transom position of each outboard.

Use *Evinrude Diagnostics* software v 6.4 or higher to set engine instance.

1. Connect the PC to the *NMEA 2000* network. Turn the key switch ON. Open the *Evinrude Diagnostics* software program.
2. From the *Device List* select the *EMM* for the first outboard.



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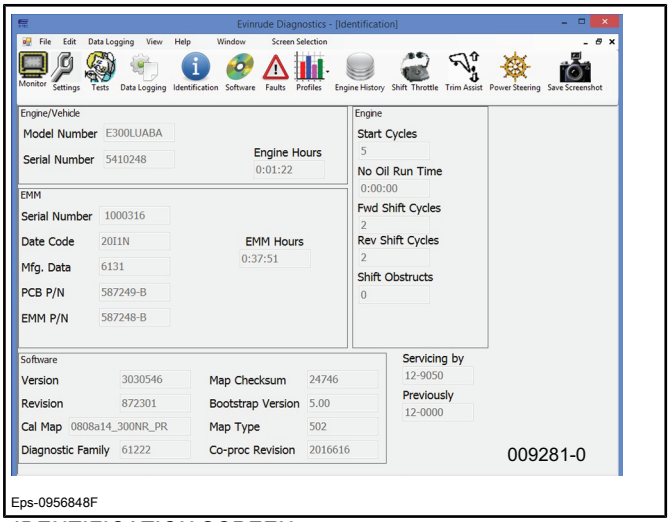
DEVICE LIST

3. Select the Identification screen and note the model number and serial number of the outboard.



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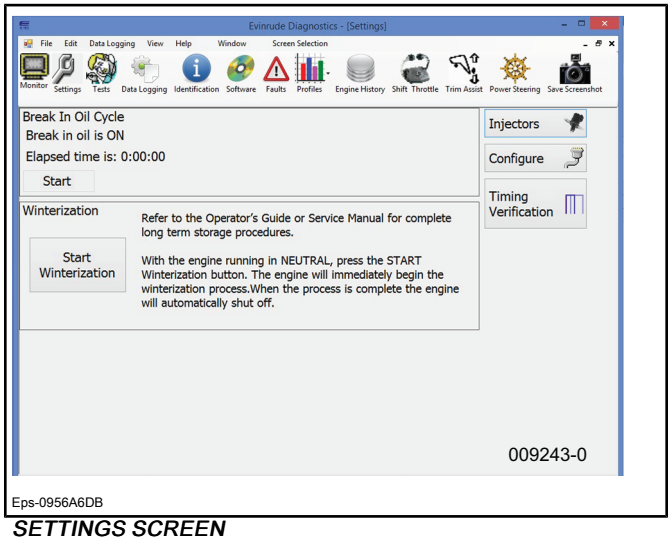
IDENTIFICATION SCREEN

Compare the information on the *Identification* screen to the serial number tag to determine the outboard transom position and engine instance. See the Identity numbers chart in **Multiple Engine Instancing**.

Close the *Identification* screen.

4. Select the *Settings* screen then select the *Configure* button.



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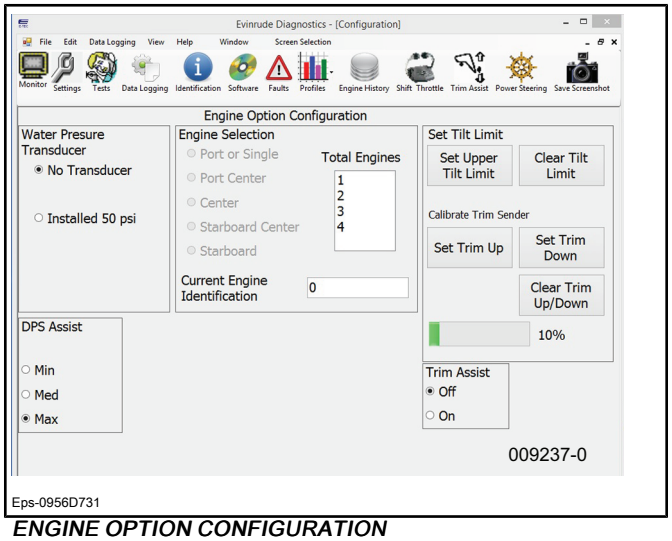
SETTINGS SCREEN

5. Under *Engine Option Configuration*, select the total number of engines.
6. Then select the engine's transom position from the available *Engine Selection* list.



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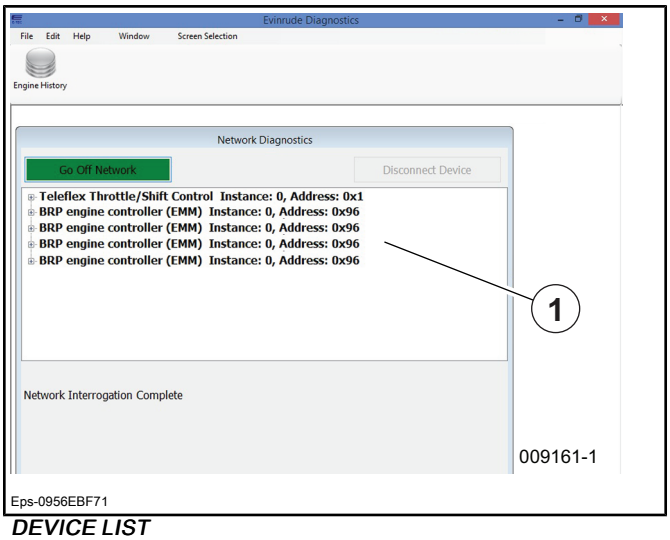
ENGINE OPTION CONFIGURATION

7. Close the *Configuration* screen. Then close the *Settings* screen.
8. From the *Device List* select *Disconnect Device*.
9. From the *Device List* select the *EMM* for the next outboard.



DEVICE LIST

10. Repeat steps 3 through 9 for each outboard.
11. After engine identity has been set for each outboard, turn the key switch OFF and back ON to complete the procedure.

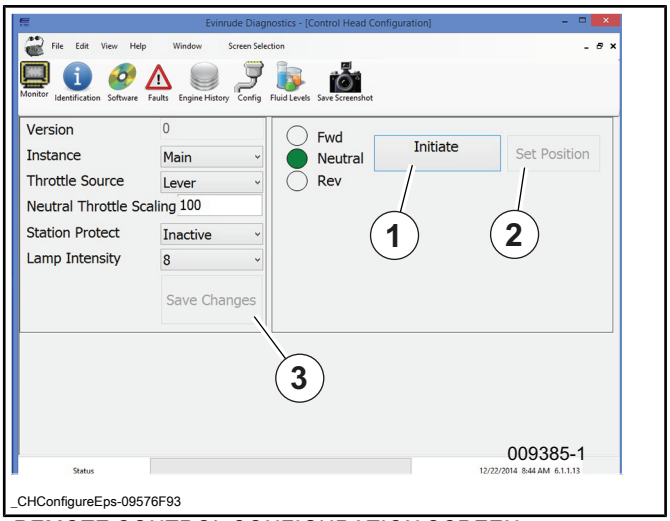
    Connecting to each *EMM* and confirm the instance of each outboard is correctly set according to transom position.

Remote Control Configuration

1. Select the *Config* button to make remote control configurations changes or calibrate the remote control lever(s).

NOTE: After making setting selections, be sure to press the *Save Changes* button.

2. To calibrate the remote control lever(s), press the *Initiate* button to start the procedure.
3. Following the on-screen prompts, move the control lever to the directed position, then press the *Set Position* button.

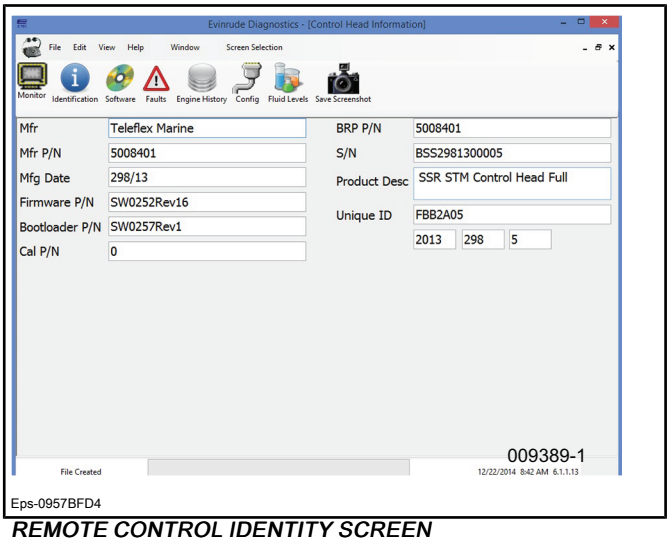


REMOTE CONTROL CONFIGURATION SCREEN

1. *Initiate calibration button*
2. *Set Position button*
3. *Save changes button*

Remote Control Identity

1. Select the *Identification* button to view identification information.

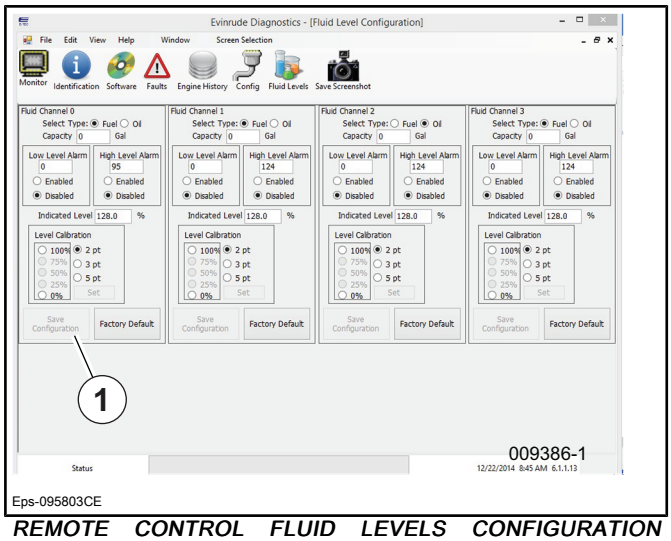


REMOTE CONTROL IDENTITY SCREEN

Fluid Level Configuration

1. Select the *Fluid Levels* button to configure fuel or oil level sensors connected to the remote control network.

NOTE: After making selections, be sure to press the *Save Configuration* button for the selected fluid channel.



Eps-095803CE

REMOTE CONTROL FLUID LEVELS CONFIGURATION SCREEN

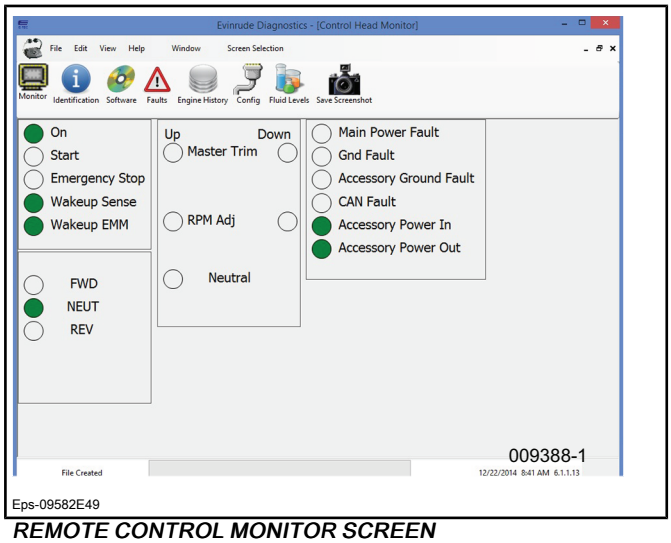
1. Save configuration button

If equipped, fluid levels can also be configured using an *Evinrude ICON Touch* digital display. See the **User's Guide** for the digital display.

Remote Control Monitor

1. Select the *Monitor* button to view certain power faults and remote control functions.

NOTE: On-screen indicators will illuminate when the related function on the remote control is activated.



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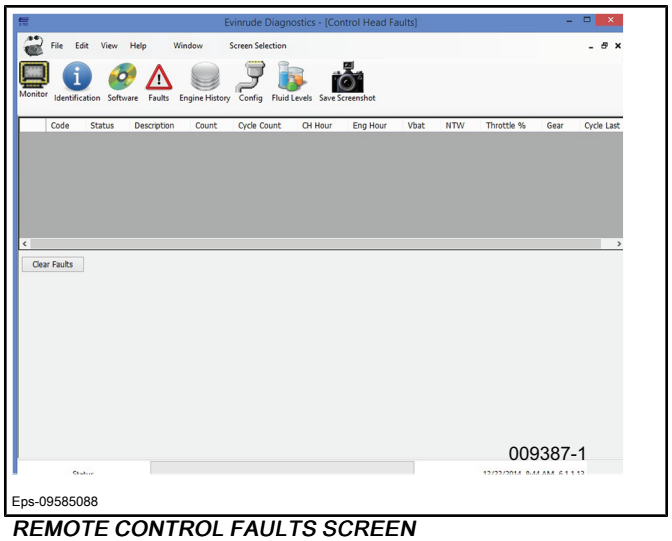
REMOTE CONTROL MONITOR SCREEN

Remote Control Faults

1. Select the *Faults* button to view any remote control fault codes.



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REMOTE CONTROL FAULTS SCREEN

ICON II System Neutral Idle Mode

The following conditions will cause the *ICON II* system to enter NEUTRAL idle mode:

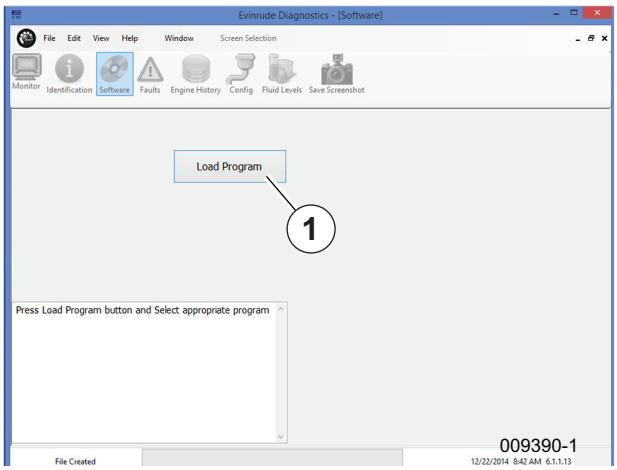
- Remote control lever sensor failure
- Foot throttle sensor failure
- Loss of communication with the *EMM*

The *EMM*:

- Activates NEUTRAL idle mode
- Stores remote control fault code between 1 and 12; or, 21, 24, 27, or 30.
- Engine Monitor: CHECK ENGINE display ON

Remote Control Software

1. Select the *Software* button to upload software to the remote control.
2. Press the *Load Software* button and follow the on-screen prompts.



REMOTE CONTROL SOFTWARE SCREEN

1. Load Software button

ICON II System Fault Detection

Type	Description	Response	Indication
Condition code or warning	A conditional fault requiring remedial action to correct that does not affect normal operation. Example: Attempt to start outboard(s) with control lever(s) not in NEUTRAL.	Response based on condition - upon resolution the system will resume full performance.	Condition specific warning message appears on digital display.
Controllable	Faults that allows for a fully controllable remedial action. Example: Low battery voltage.	Information only	
Critical	Faults that result in the inability to accurately determine critical outboard commands. Example: Communication between the control and outboard(s) EMM(s) is lost.	Commanded lever and gear positions become unavailable. Outboards set to *S.A.F.E.* mode.	Control LEDs flash five times per second. Warning message appears on digital display.

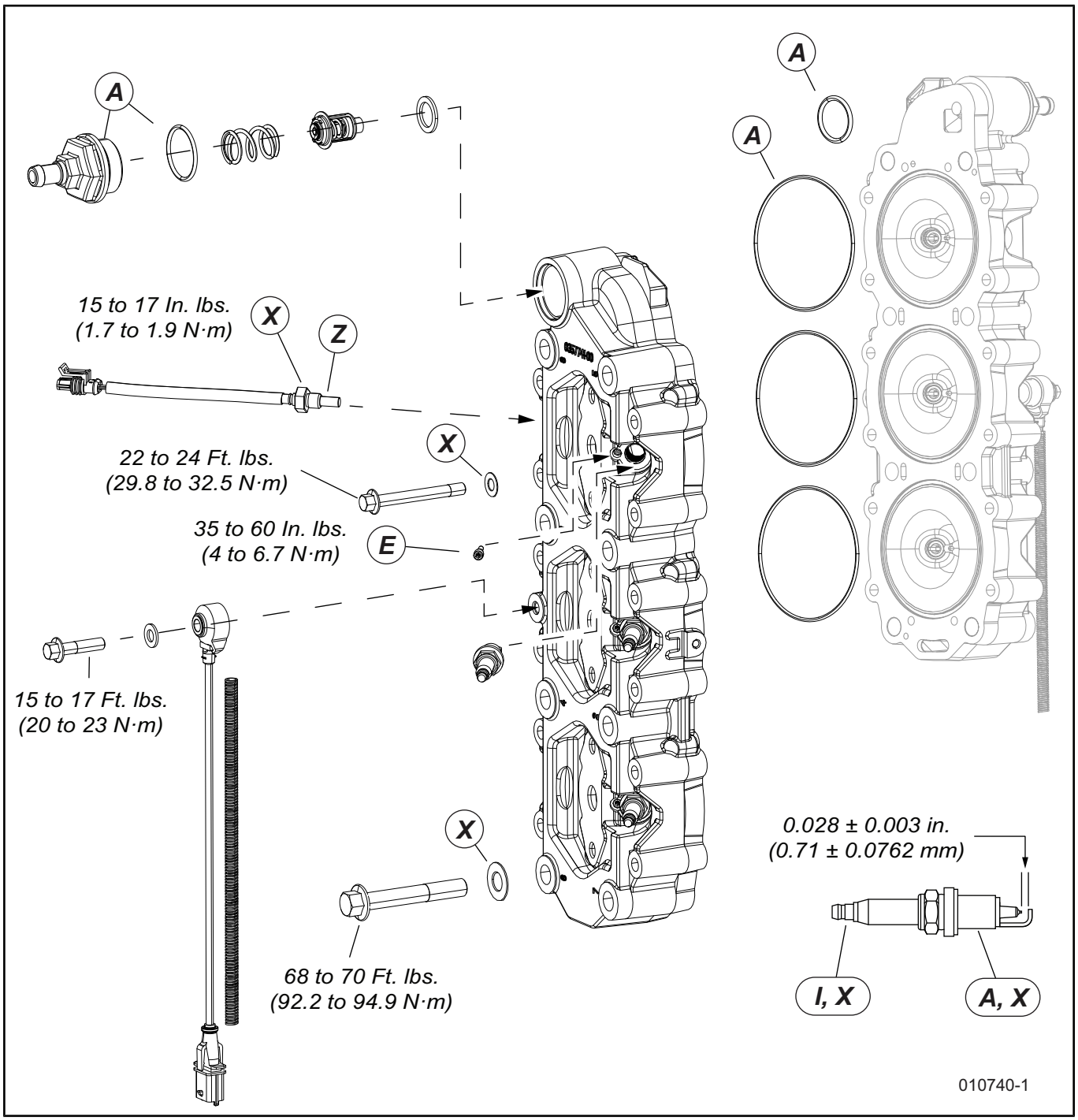
A critical fault will prevent normal operation and result in the system entering a failed state. The control will:

– send “not available” data in the throttle and gear messages
– deactivate SYNC, NEUTRAL and Throttle Warm-Up modes
– send the fault message and store the fault in the remote control memory
– flash the appropriate remote control LED(s) five times per second

When the control detects the outboard(s) are in NEUTRAL idle and the working lever(s) are in NEUTRAL, the system returns to normal operation.

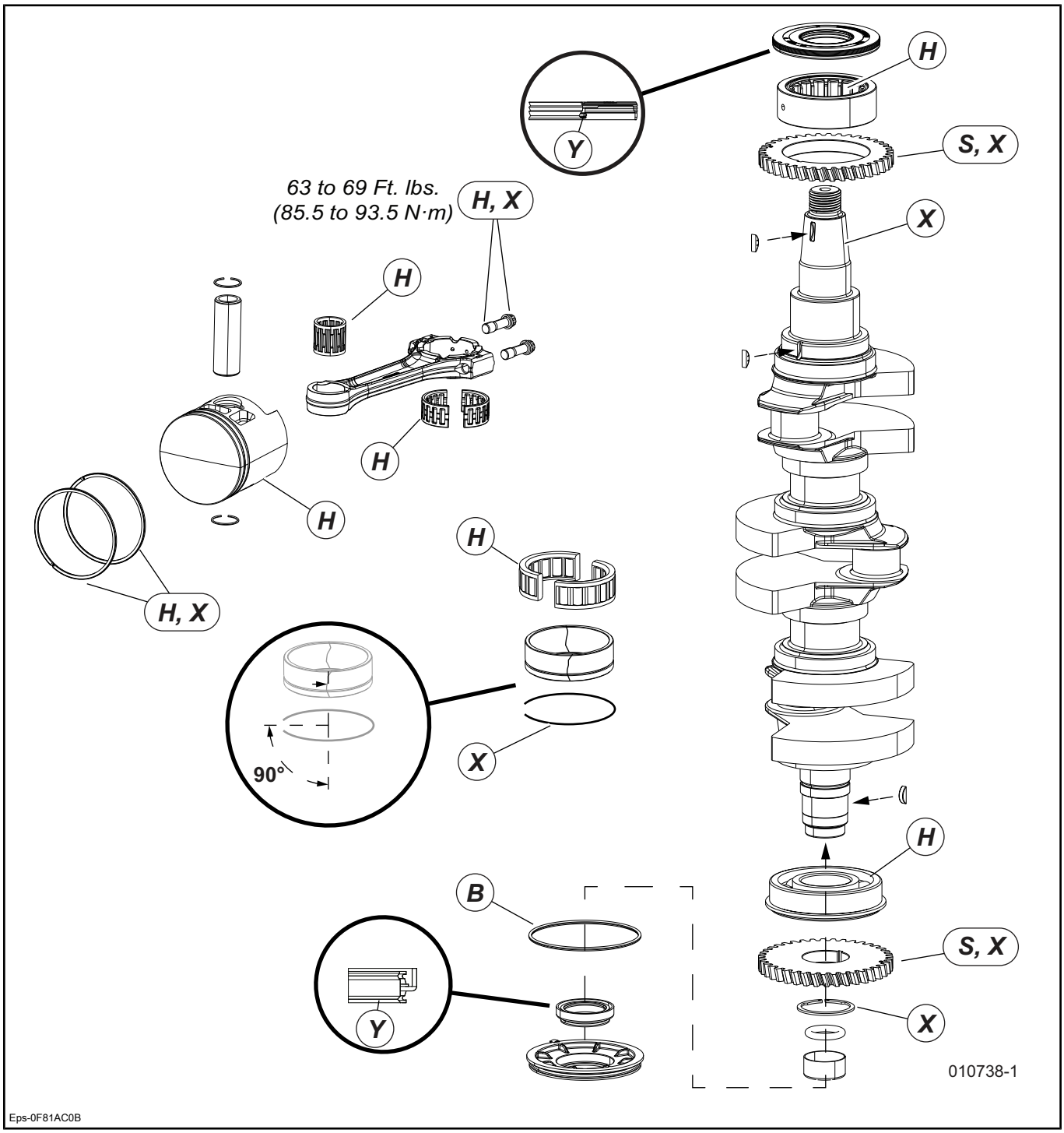
Powerhead

Service Charts: Cylinder Head



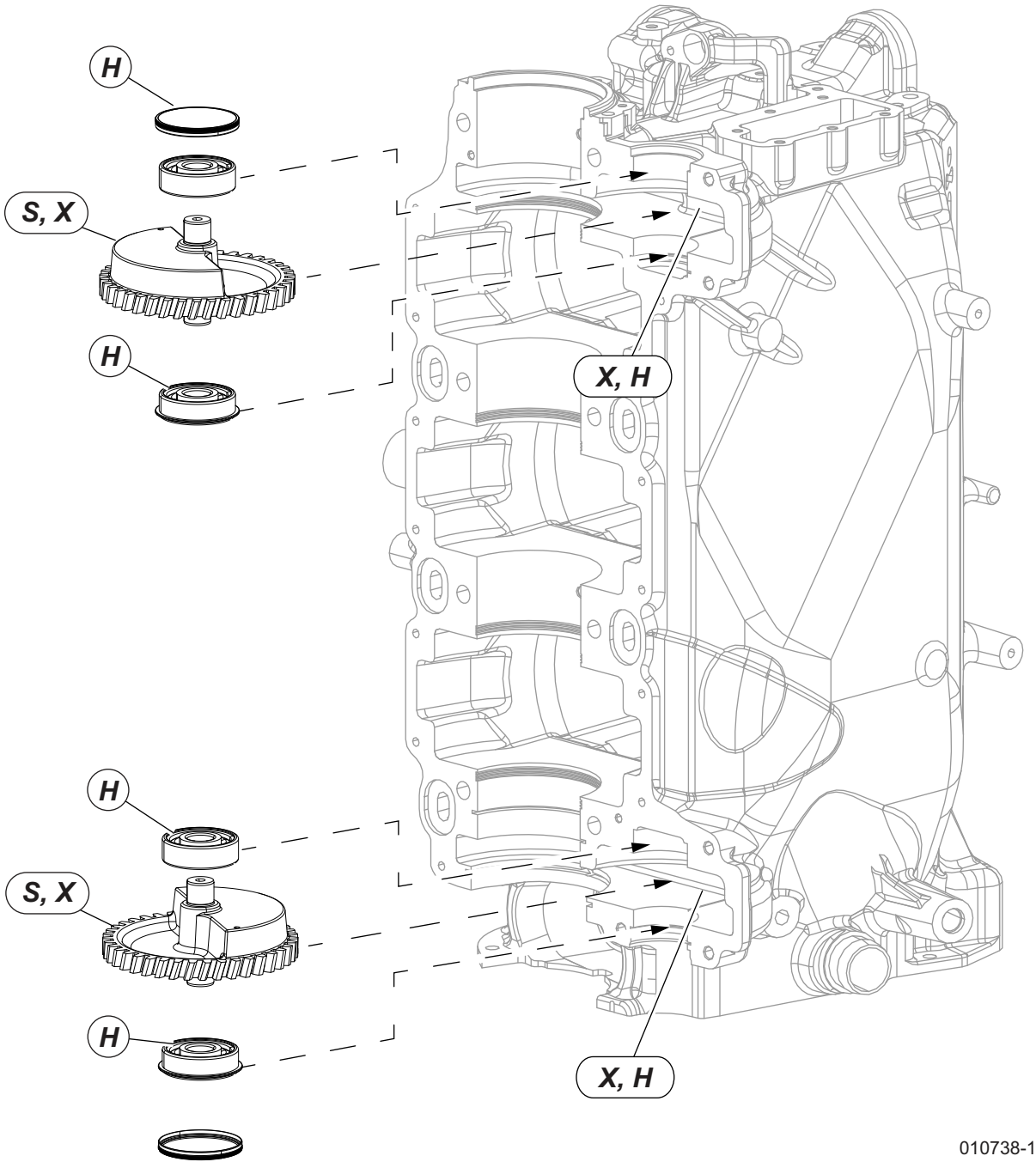
A	*Triple Guard* grease	***E***	Ultra Lock
I	Dielectric Grease	***X***	See Service Manual procedure
Z	Thermal Joint Compound		

Service Charts: Crankshaft and Pistons



B	Gasket Sealing Compound	***E***	Ultra Lock
H	Outboard Lubricant	***S***	*STP Oil Treatment*
X	See Service Manual procedure	***Y***	Extreme Pressure Grease

Service Charts: Balance Gears



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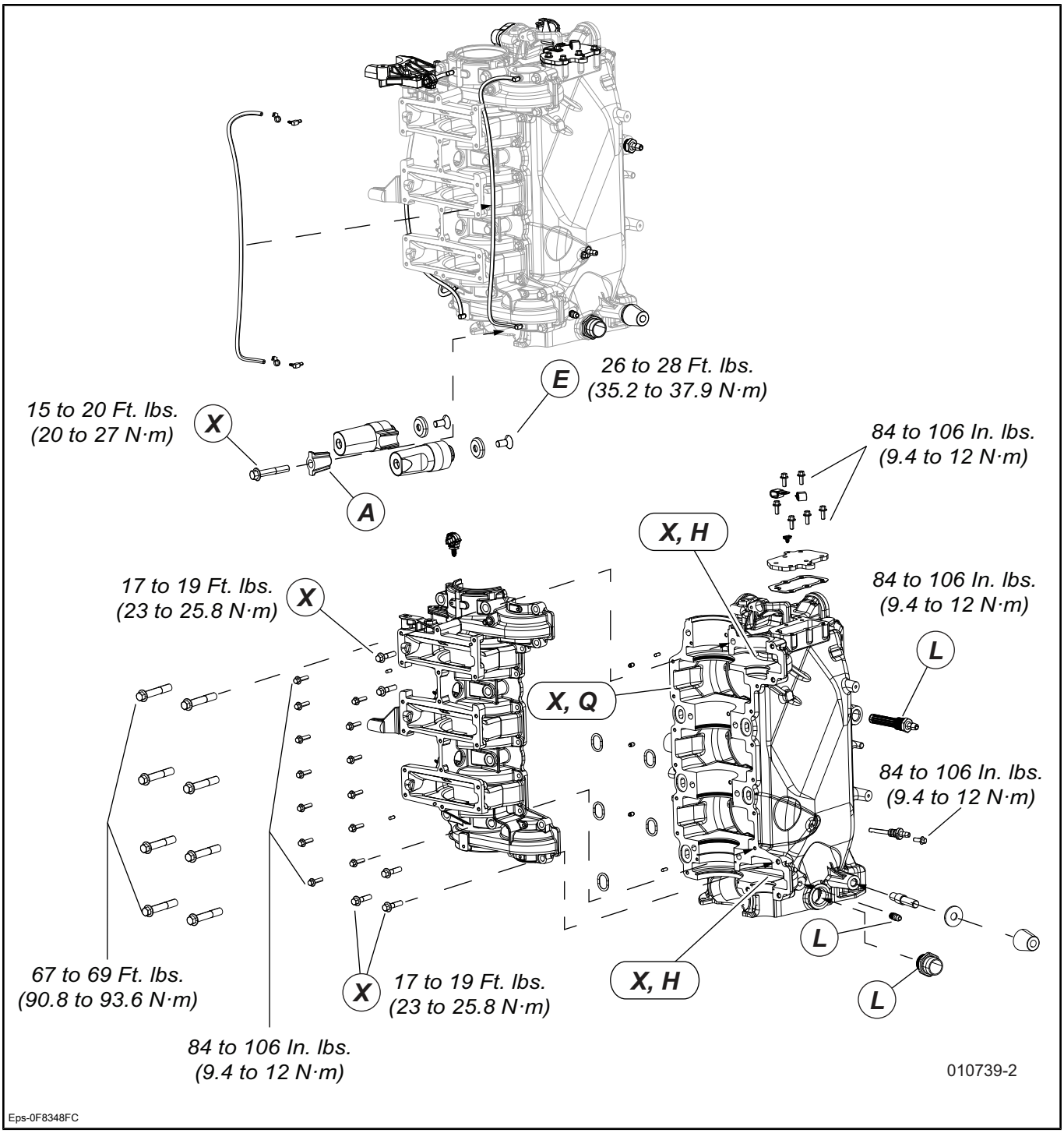
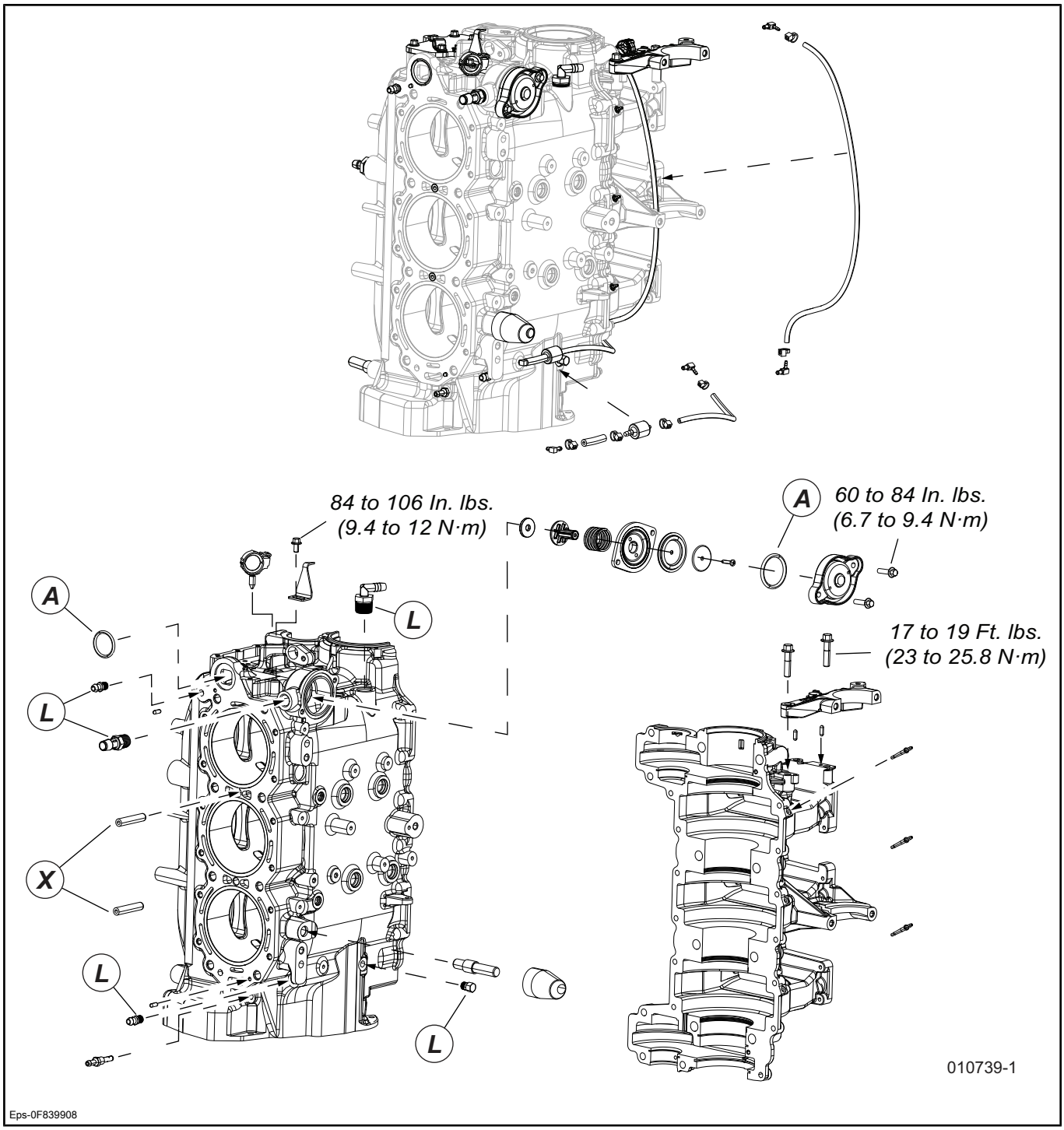
H	Outboard Lubricant	***S***	*STP Oil Treatment*
X	See Service Manual procedure		

Service Charts: Cylinder and Crankcase



Eps-0F8348FC

A	*Triple Guard* grease	***E***	Ultra Lock
H	Outboard Lubricant	***L***	Pipe Thread Sealing Compound
Q	Threebond Sealant	***X***	See Service Manual procedure



A	*Triple Guard* grease	***E***	Ultra Lock
H	Outboard Lubricant	***L***	Pipe Thread Sealing Compound
Q	Threebond Sealant	***X***	See Service Manual procedure

Compression Testing

1. Start and run outboard until it achieves operating temperature, then shut OFF.
2. Disconnect crankshaft position sensor (CPS) connector.
3. Remove all spark plugs.
4. Install compression tester's hose attachment into spark plug hole (14 mm threads).
5. Turn the key switch to the ON position.
6. Crank the engine.

NOTE: While cranking outboard with starter, note maximum pressure reading on gauge.

7. Repeat procedure for each cylinder.
8. Return throttle to idle position and reconnect CPS connector.
9. Replace spark plugs.

If engine shows a variation greater than 15 psi (100 kPa) between cylinders, check for:

– damaged cylinder head
– damaged pistons
– broken or stuck piston rings
– scored cylinder walls

Powerhead Removal

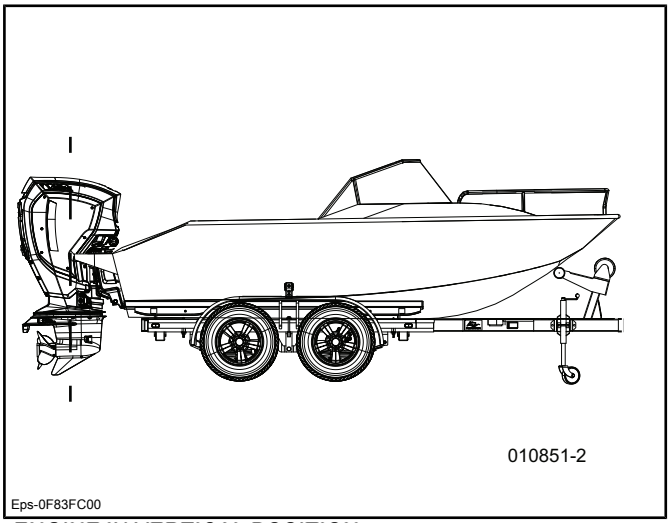
SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING FIXTURE	P/N 357667	233, 235

⚠ WARNING

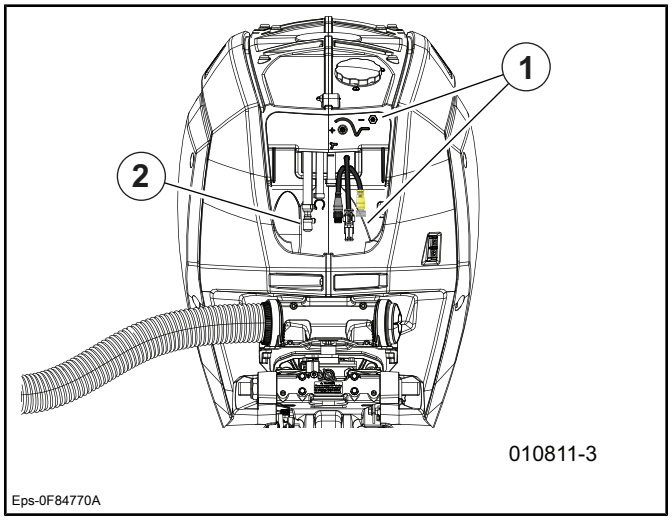
Protect against hazardous fuel spray. Before starting any fuel system service, carefully relieve fuel system pressure. Refer to Relieving Fuel System Pressure..
To prevent accidental starting while servicing, twist and remove spark plug leads.

1. Trim the engine to the vertical position.



ENGINE IN VERTICAL POSITION

2. Disconnect the battery cables at the battery.
   1. Disconnect the negative (–) cable first.
   2. Disconnect the positive (**+**) cable last.
3. Remove the top engine cover. Refer to **Engine Cover and Frame Service**.
4. Disconnect all rigging; battery cables, buss cables and fuel and oil hoses from the engine. Cap the fuel and oil hoses. Disconnect trim relay electrical connectors.



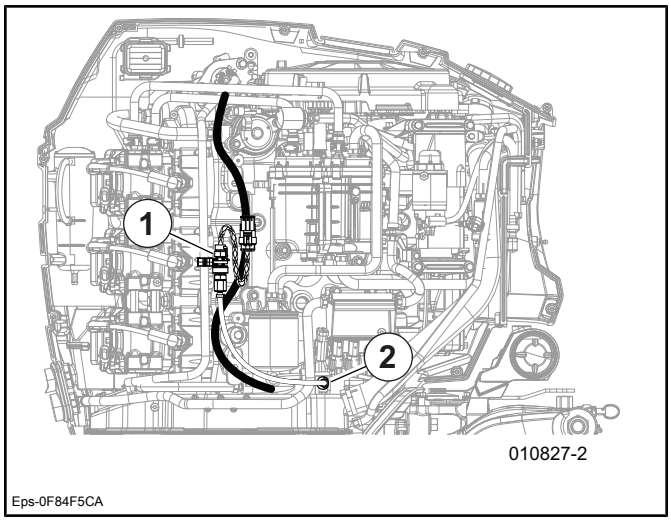
1. Battery and network cables
2. Cap fuel and oil hoses

It is not necessary to remove hydraulic steering hoses from the DPS manifold on DPS models.

IMPORTANT: If hydraulic steering hoses are removed, cap the DPS manifold fittings and hydraulic hose fittings to prevent fluid contamination and leaks.

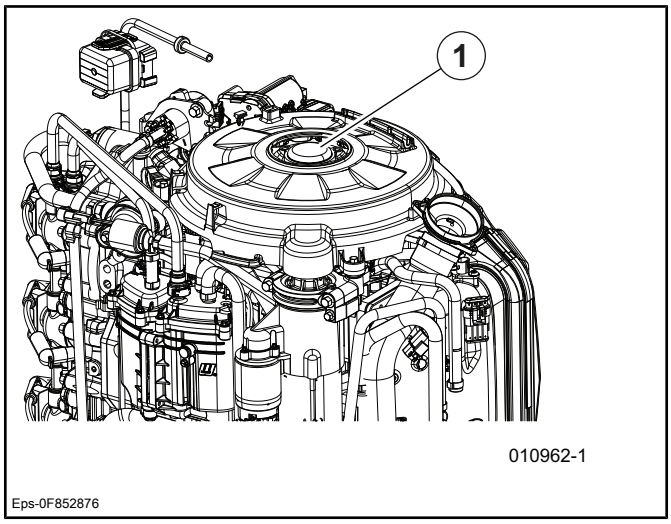
IMPORTANT: Take care not to kink hydraulic steering hoses during powerhead replacement.

5. Remove the rear cover, port and starboard frames. Refer to **Engine Cover and Frame Service**.
6. If replacing the powerhead remove the water pressure sensor and block hose fitting, if equipped. Set these parts aside for re-use on the new powerhead.



1. Water pressure sensor
2. Block hose fitting

7. Remove thread protector from the flywheel threads.

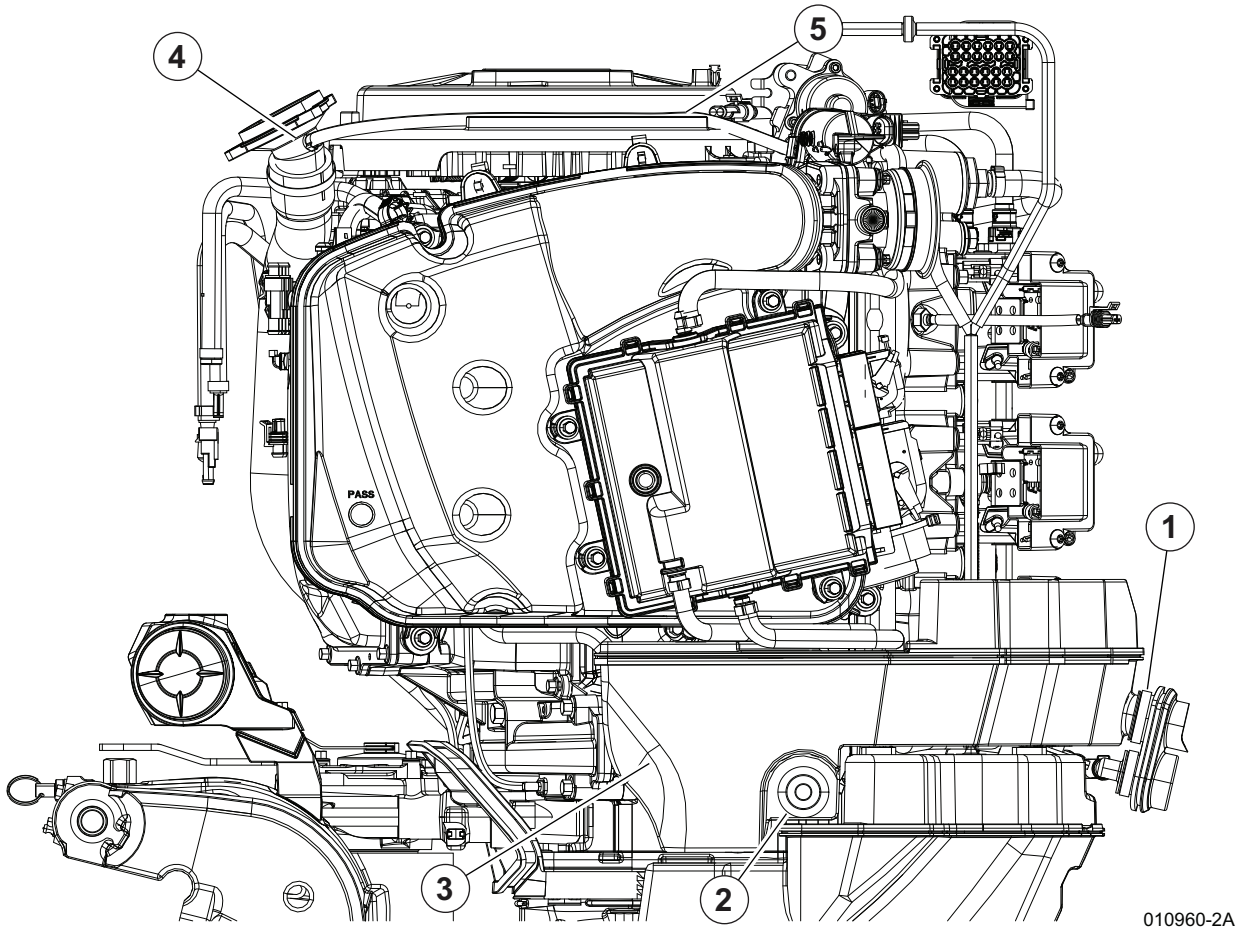


1. Thread protector

Port

Remove the following hose clamps and hoses:

1. 38.1 mm clamp – Muffler to exhaust grommet, then remove the grommet from the muffler.
2. Remove the rubber mount.
3. Remove the muffler. Refer to **Exhaust Relief Muffler Service**.
4. 10.5 mm clamp – Oil vent hose, then remove the hose from the oil fill neck.
5. Remove the oil vent hose from the flywheel cover.



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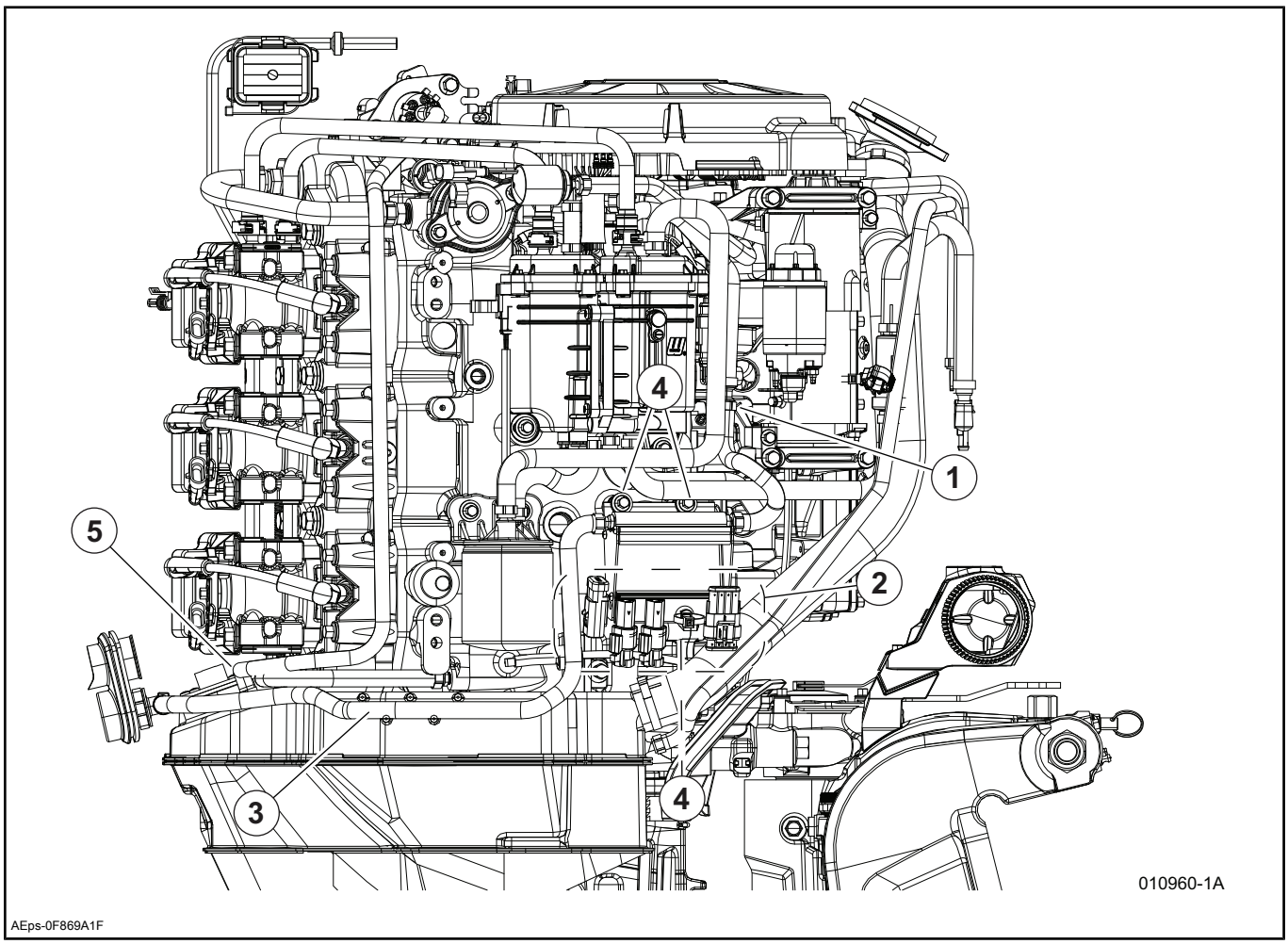
Starboard

Remove the following hose clamps and hoses:

1. 15.7 mm clamp – Cooling water hose to connector, then remove the hose from the connector.
2. If equipped, disconnect the electrical connectors from the DPS module.
3. Remove the cooling water hose from the retainer on the oil tank.
4. If equipped, remove the three screws from the DPS module and remove the DPS module, cooling water hose and exhaust grommet as an assembly.
5. 15.7 mm clamp – Oil pick up to oil supply hose, then remove the hose from the pick up.



6. Remove the oil tank. Refer to **Oil Tank Removal**.
7. Disconnect the shift actuator from the engine harness. Refer to **Gearcase Removal**.

Lifting the Powerhead

⚠ WARNING

To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

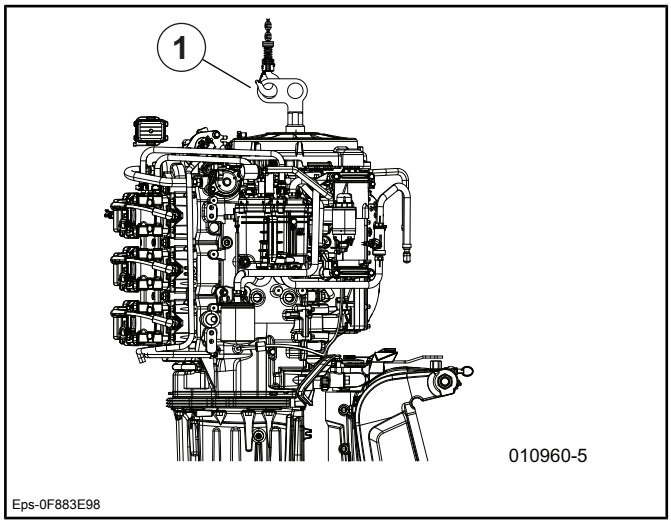
1. Use Engine Lifting Fixture, P/N 357667, to lift the powerhead from the adapter.

Required Tool
Engine Lifting Fixture P/N 357667

2. Use the off-set lifting eye to remove and install the powerhead, or to support the engine and remove and install the stern and swivel bracket assembly.

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

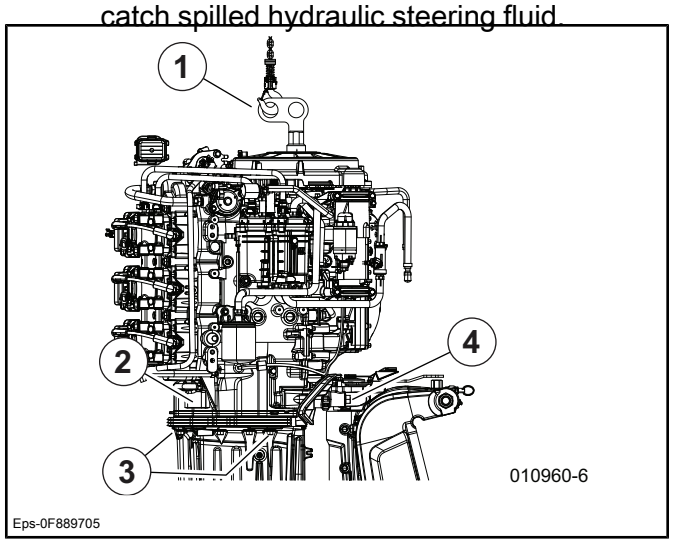
3. Install the lifting fixture completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.
4. Make sure the off-set lifting eye is to the REAR of the engine.
5. Fasten appropriate chain hook to the off-set lifting eye.



1. Off-set lifting eye to REAR of engine

6. Lift the hoist to remove all slack from the chain and support the powerhead.
7. Remove two screws from the rear of the powerhead base flange (one starboard and one port).
8. Remove eight screws and washers from the exhaust housing (four starboard and four port). Then remove the two upper mount bolts.

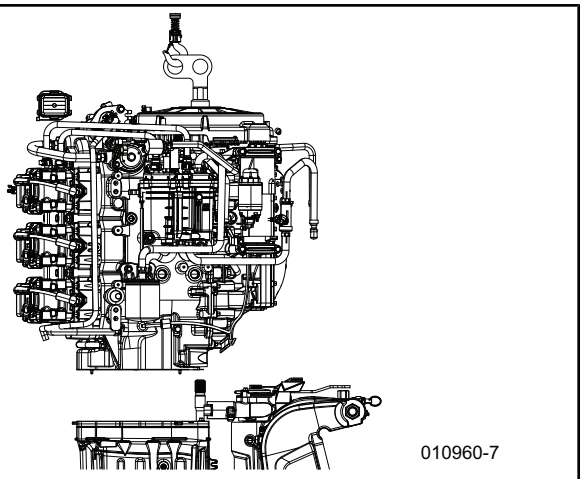
Service Tips:
1. Turn the outboard for ease of access to the upper mount bolts.
2. If DPS hydraulic steering hoses have been removed, open the bleed valves to turn the engine. Use an appropriate container to catch spilled hydraulic steering fluid.



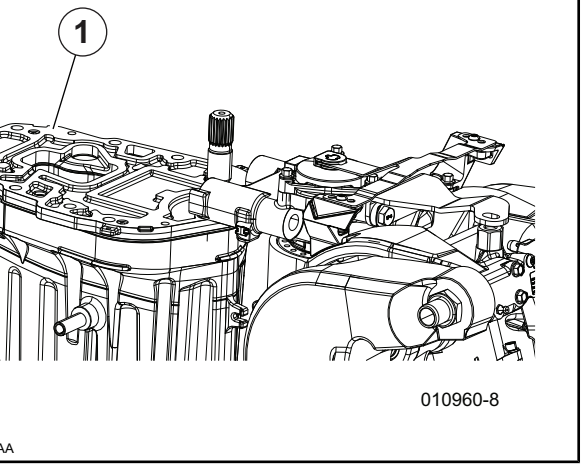
1. Remove all slack from chain
2. Two screws
3. Four screws and washers
4. Upper mount bolts

9. Carefully lift the powerhead from the exhaust adapter.

IMPORTANT: If the powerhead does not lift easily, check for any fasteners or hose connections that may have been overlooked during the removal procedures.



10. Remove the gasket from the exhaust adapter.
11. Remove all the old gasket material from the exhaust adapter mating surfaces. Clean the adapter with solvent.



1. Exhaust adapter surface

⚠ WARNING

To avoid personal injury, make sure the capacity of the engine stand is at least twice the weight of the outboard.

12. Secure the powerhead in a suitable engine stand.

Powerhead Installation

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING FIXTURE	P/N 357667	233, 235

SERVICE PRODUCTS

Description	Part Number	Page
MOLY LUBE	P/N 768306	235

Powerhead Installation

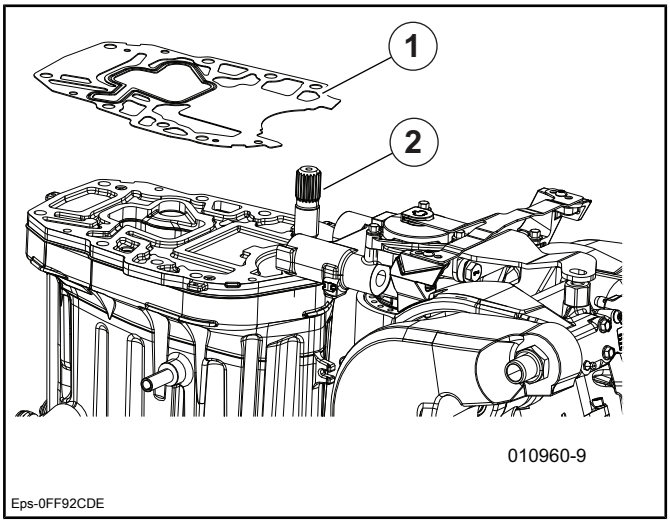
For clarity, some pictures do not show the exhaust housing to frame sealing grommet.

IMPORTANT: If installing a replacement, or warranty dressed powerhead, FOLLOW all additional instructions provided in included instruction sheets.

1. Install the a new gasket onto the exhaust adapter. Do NOT apply any adhesive to the gasket.

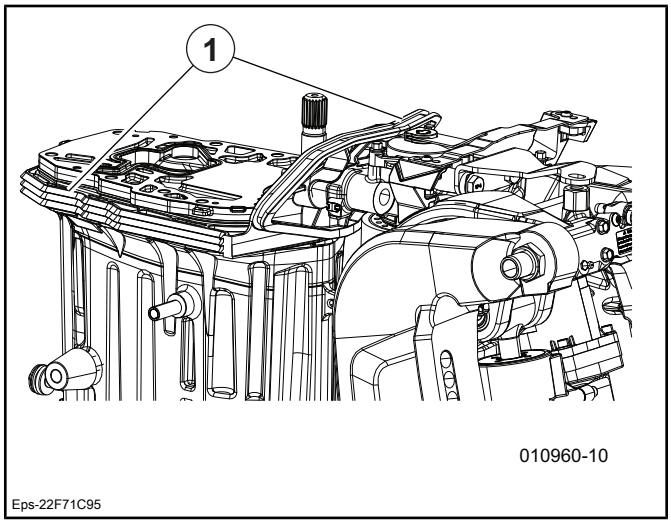
Required Chemical
Moly Lube **P/N 768306**

2. Apply Moly Lube, P/N 768306, to the splines of the driveshaft.



1. Gasket
2. Driveshaft splines

3. After installing the gasket, ensure the exhaust housing to frame sealing grommet is installed on the exhaust housing as shown.



1. Grommet

4. If installing a new powerhead, remove the powerhead from the shipping container.

⚠ WARNING

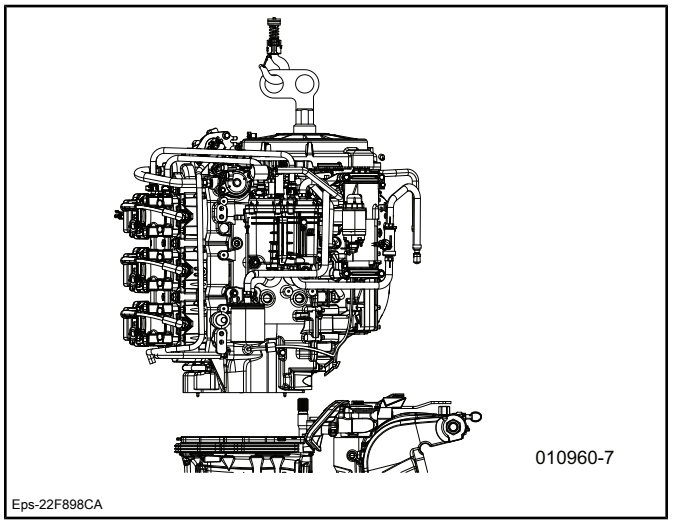
To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

Required Tool
Engine Lifting Fixture **P/N 357667**

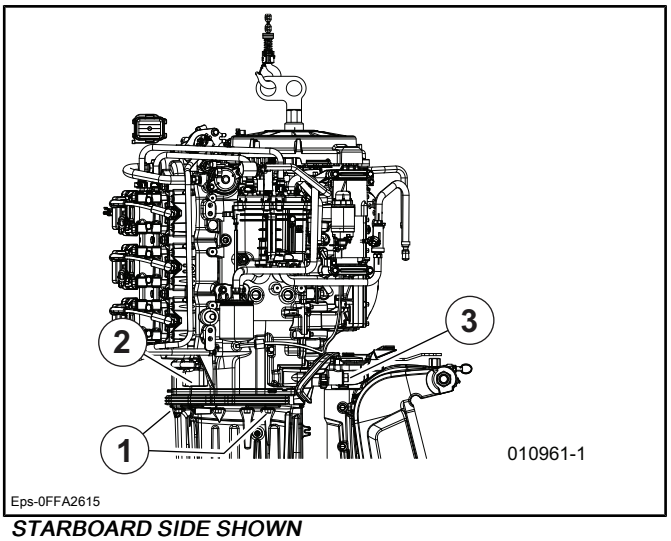
5. Use the off-set lifting eye of the Engine Lifting Fixture, P/N 357667, to lift the powerhead. Use the off-set lifting eye to lift the powerhead.

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. Do NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

6. Install the lifting fixture completely into the flywheel. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.
7. Make sure the off-set lifting eye is to the REAR of the engine.
8. Fasten appropriate chain hook to the off-set lifting eye.
9. Slowly lower the powerhead into position. It may be necessary to turn the flywheel to align the crankshaft splines with the driveshaft splines.



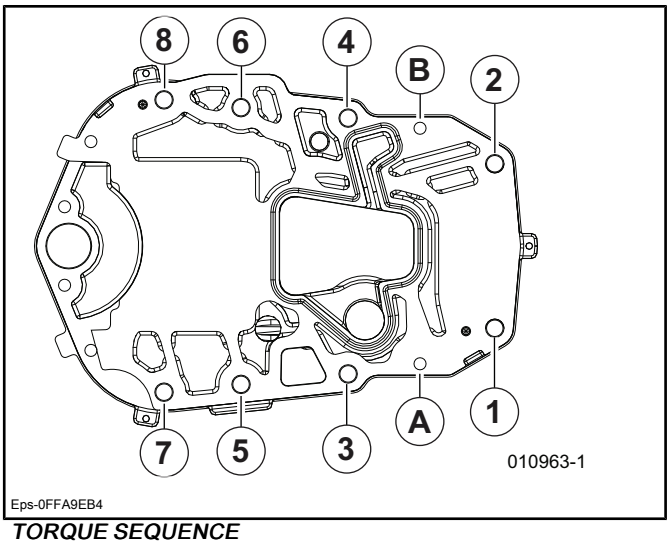
10. Install two screws into the rear of the powerhead base flange (one starboard and one port).
11. Install the eight washers and screws to retain the powerhead to the exhaust adapter and exhaust housing.
12. Then install the two upper mount bolts.



STARBOARD SIDE SHOWN
1. Two screws
2. Four screws and washers
3. Upper mount bolts

Tightening Torque Sequence

13. Tighten fasteners in the order and sequence listed:
    1. Tighten the eight screws in the sequence shown to a torque of 22 to 23 Ft. lbs. (29.9 to 32 N·m).
    2. Tighten the two screws (labeled A and B) in the sequence shown to a torque of 84 to 106 In. lbs. (9.5 to 12 N·m).



TORQUE SEQUENCE

14. Wait five (5) minutes.
    1. Then re-tighten the eight screws in the sequence shown to a torque of 22 to 23 Ft. lbs. (29.9 to 32 N·m).
    2. Tighten the upper mount bolts to a torque of 57 to 59 Ft. lbs. (77.3 to 79.9 N·m).
15. Remove the chain/hook from the lift ring and remove the lift ring from the powerhead.

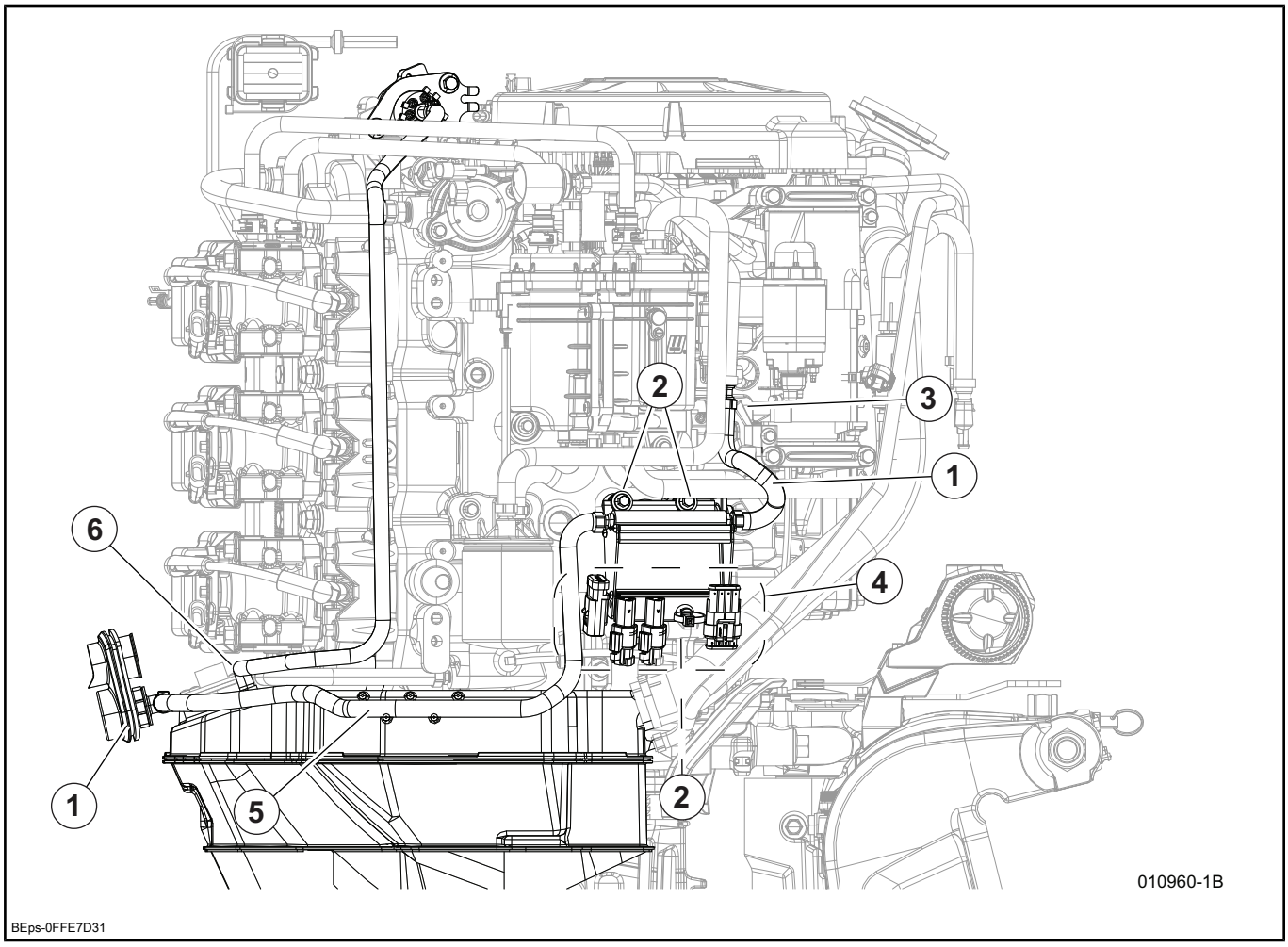
Starboard

Install The oil tank. Refer to **Oil Tank Installation**.

Connect the shift actuator to the engine harness.

Install the following:

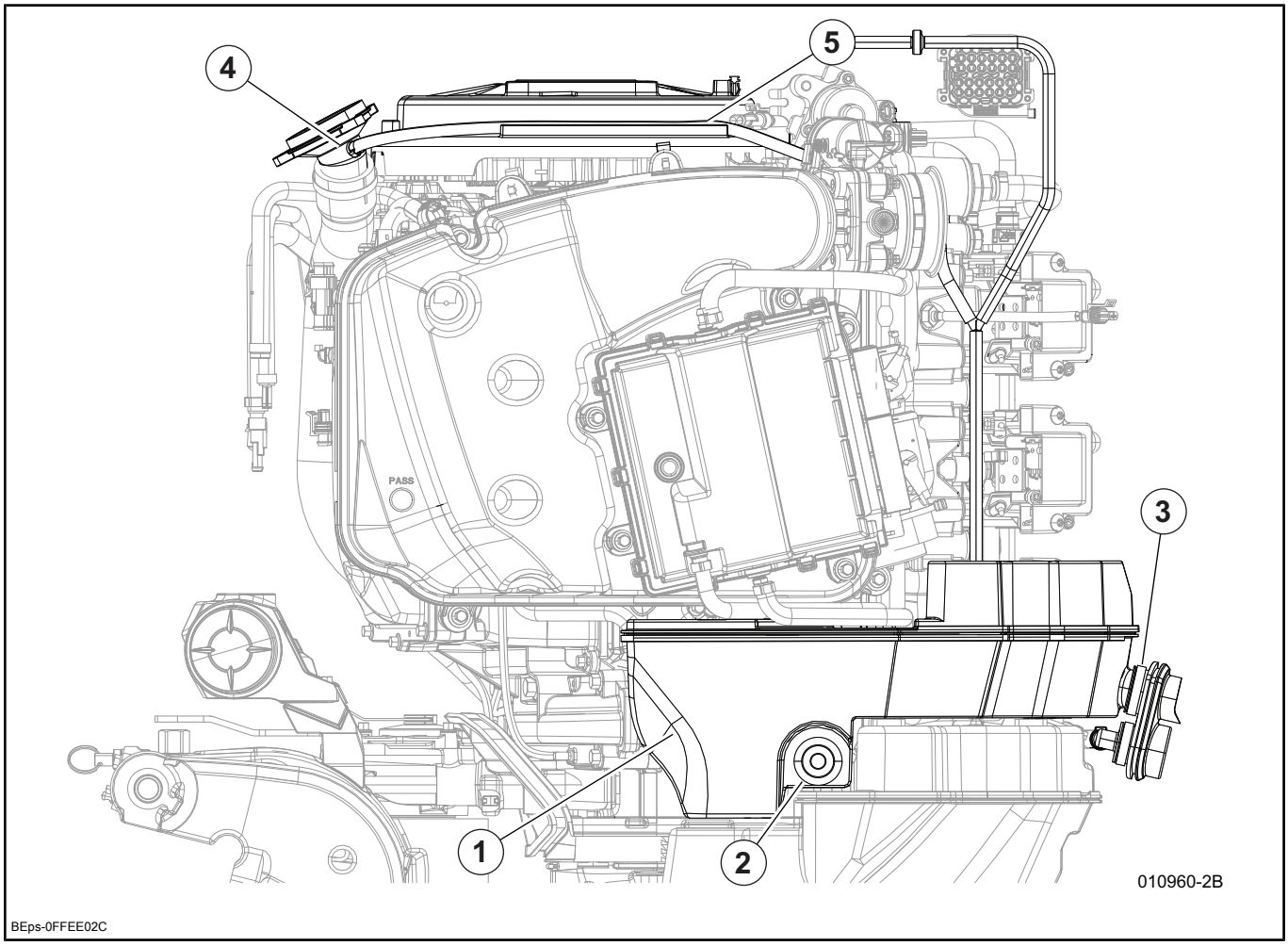
1. Cooling water hose, exhaust grommet and if equipped, DPS module.
2. The DPS module with three screws and washers. Tighten the screws to a torque of 84 to 106 In. lbs. (9.4 to 12 N·m).
3. Cooling water hose to connector with a new 15.7 mm clamp. Orient the ear of the clamp to starboard, then secure the clamp.
4. Connect the electrical connectors to the DPS module.
5. Install the cooling water hose into the retainer on the oil tank.
6. Oil supply hose to the oil pick up with a new 15.7 mm clamp. Orient the ear of the clamp toward starboard/ rear, then secure the clamp.



Port

Install the following:

1. Install the muffler seal on the powerhead fitting and install the muffler on the outboard.
2. The rubber mount.
3. The exhaust grommet with new 38.1 mm clamp. Orient the ear of the clamp to starboard and secure the clamp.
4. Oil vent hose on the oil fill neck with a new 10.5 mm clamp. Orient the ear of the clamp to forward / down and secure the clamp.
5. The oil vent hose into the retainer on the flywheel cover.



Pre-Service Adjustments

NOTICE

After installing a new or rebuilt powerhead, perform the following procedures before returning outboard to service.
Failure to perform these procedures can result in immediate damage to the powerhead.

Replacement or Rebuilt Powerheads

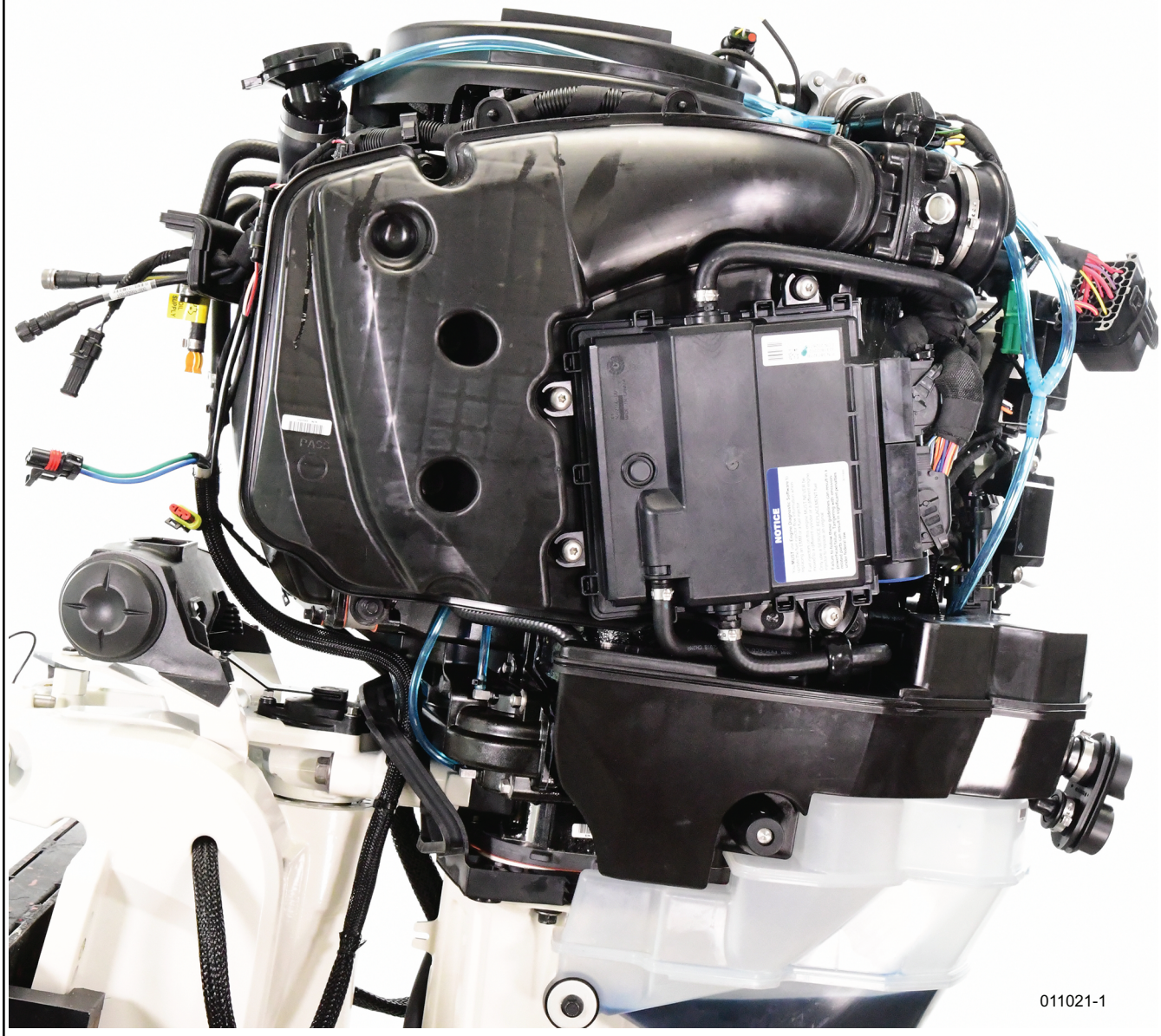
- Adjust timing pointer
- Use *Evinrude Diagnostics* software to start powerhead break-in oiling.
- Use *Evinrude Diagnostics* software to make sure engine management software version and revision are current. Update as required.
- If installing a powerhead with a new *EMM*, use *Evinrude Diagnostics* software to calibrate the shift actuator. Refer to **Shift Actuator Calibration**.
- Prime fuel system. Refer to **Fuel System Priming**.
- Prime oiling system. Refer to **Oil Supply Priming**.
- Use *Evinrude Diagnostics* software to check engine timing. Refer to **Timing Adjustments**.
- Run the outboard and check for water, fuel or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

Warranty Dressed Powerheads

- Use *Evinrude Diagnostics* software to calibrate the shift actuator. Refer to **Shift Actuator Calibration**.
- Prime fuel system. Refer to **Fuel System Priming**.
- Prime oiling system. Refer to **Oil Supply Priming**.
- Run the outboard and check for water, fuel or oil leaks.
- Make sure engine reaches correct operating temperature and does not overheat.

Powerhead Views

Port



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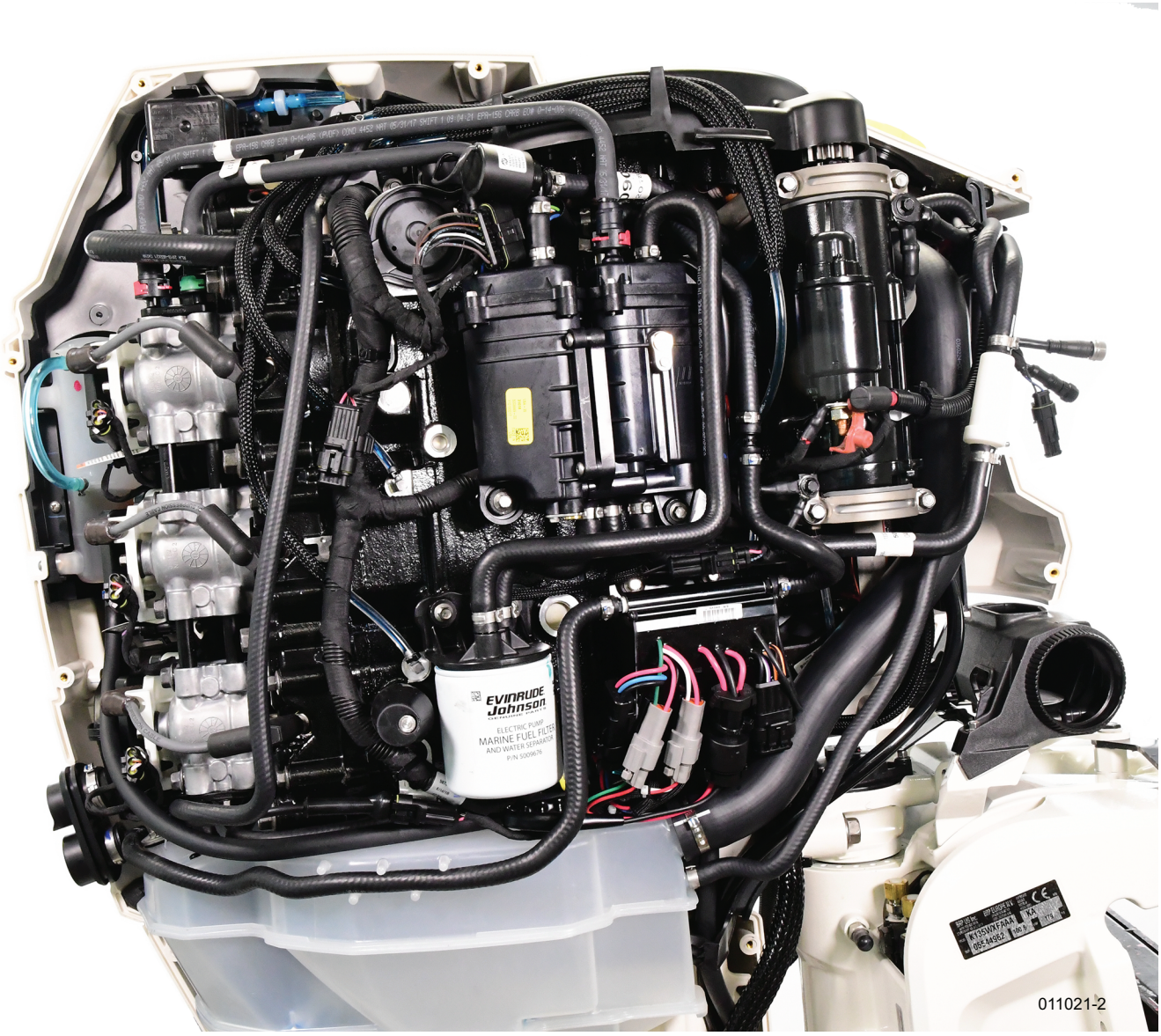
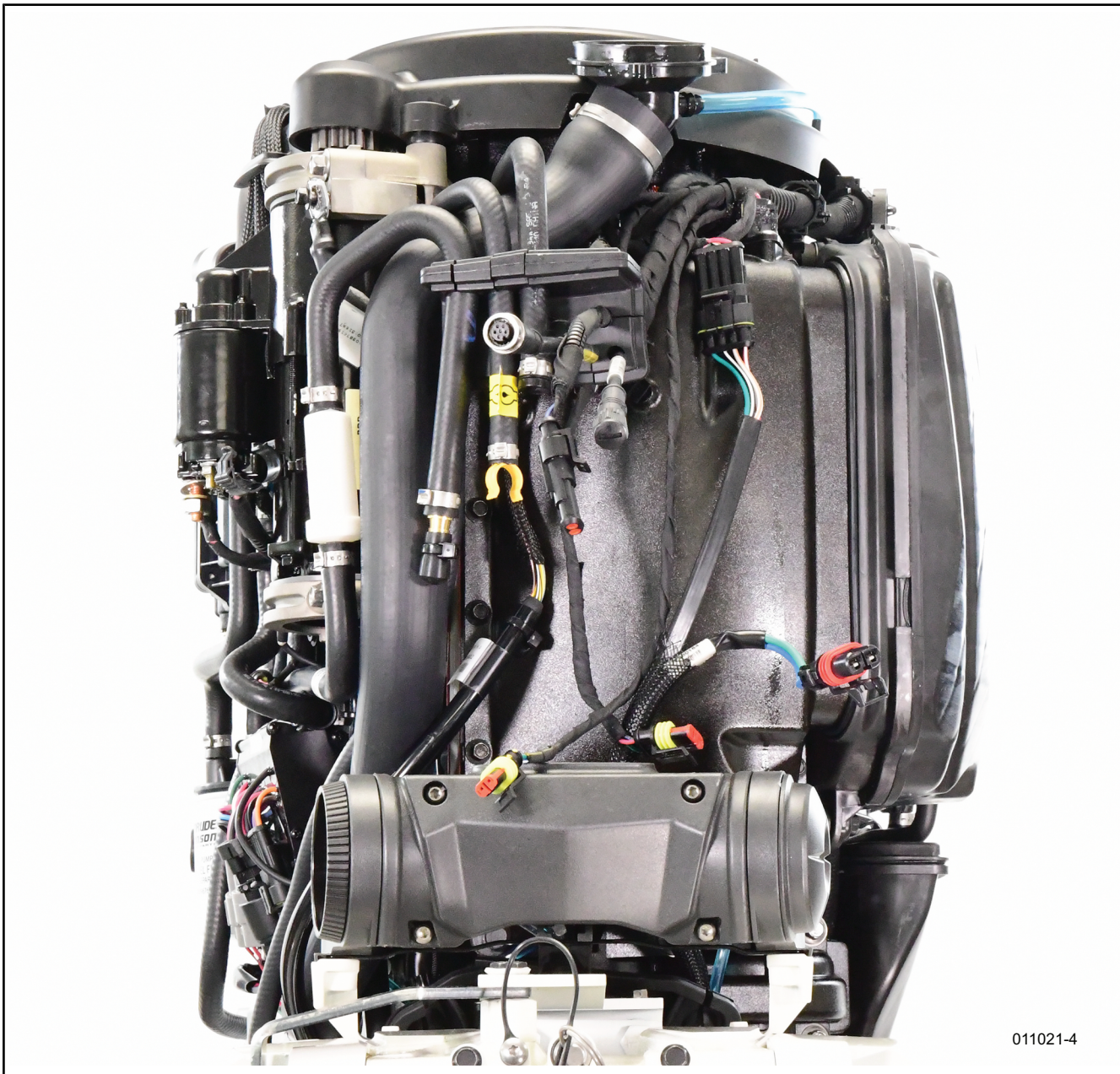
Starboard–DPS



Starboard–non DPS

new image coming soon

Front



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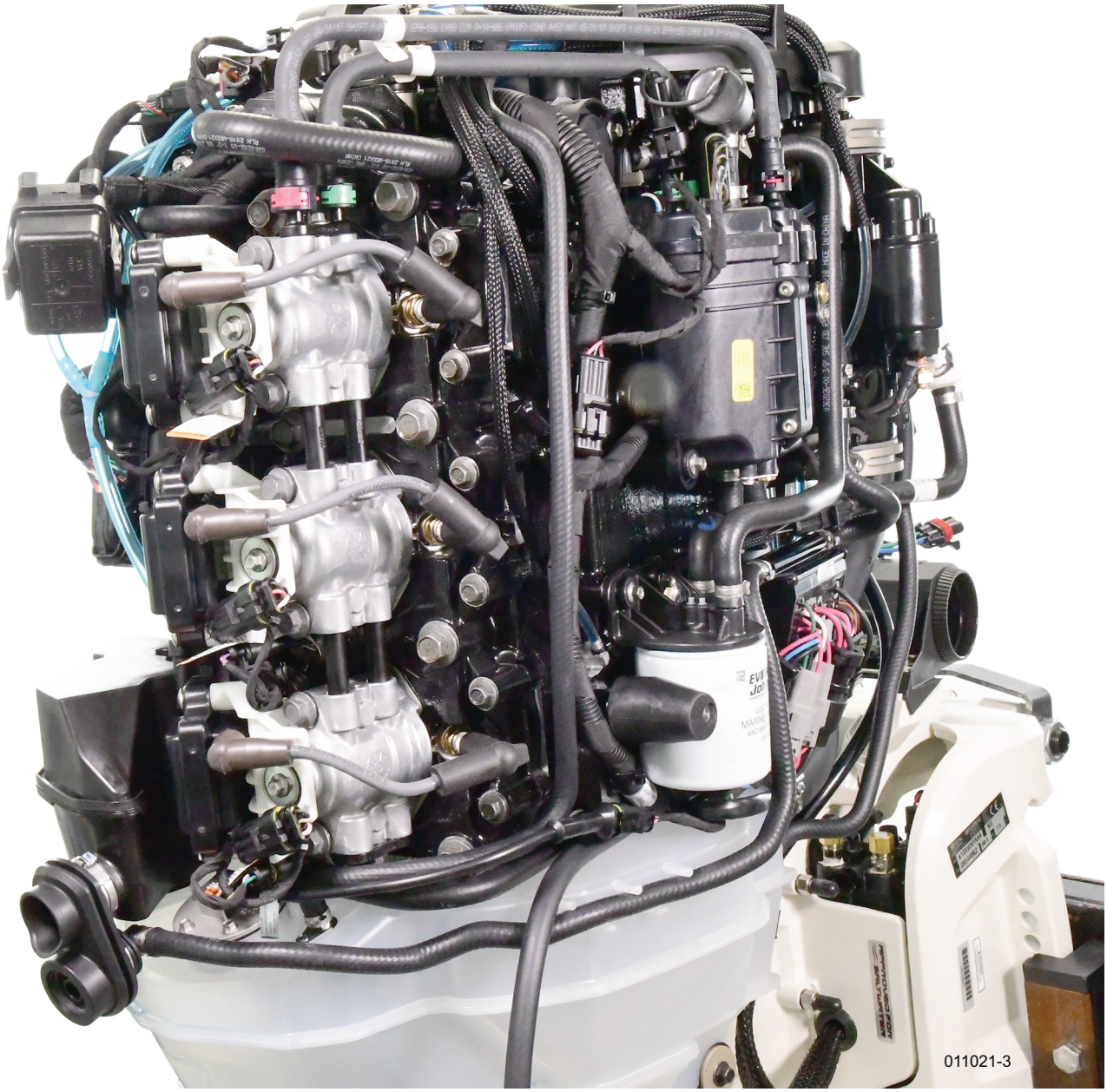
Rear



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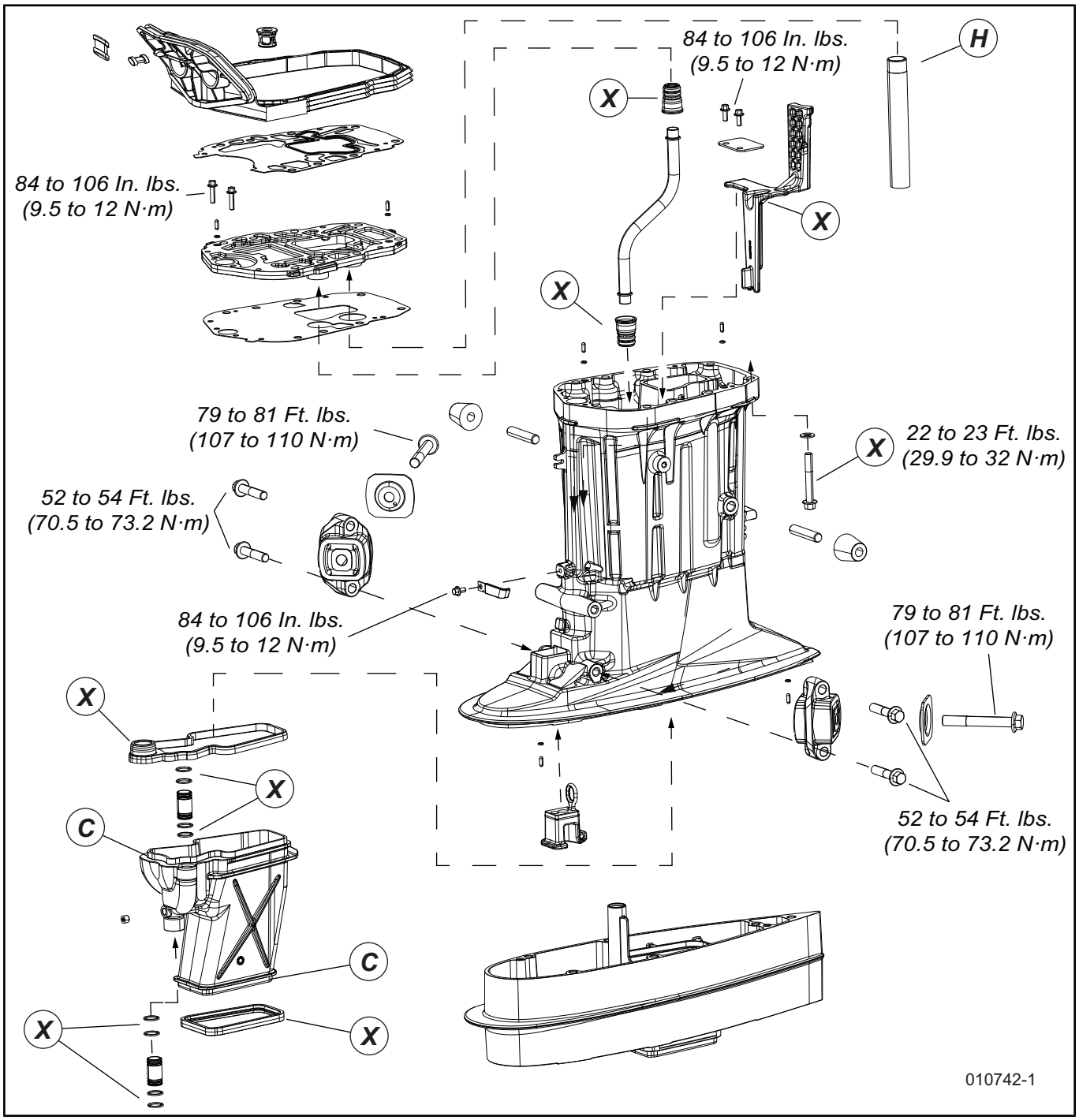
Exhaust Housing and Adapter

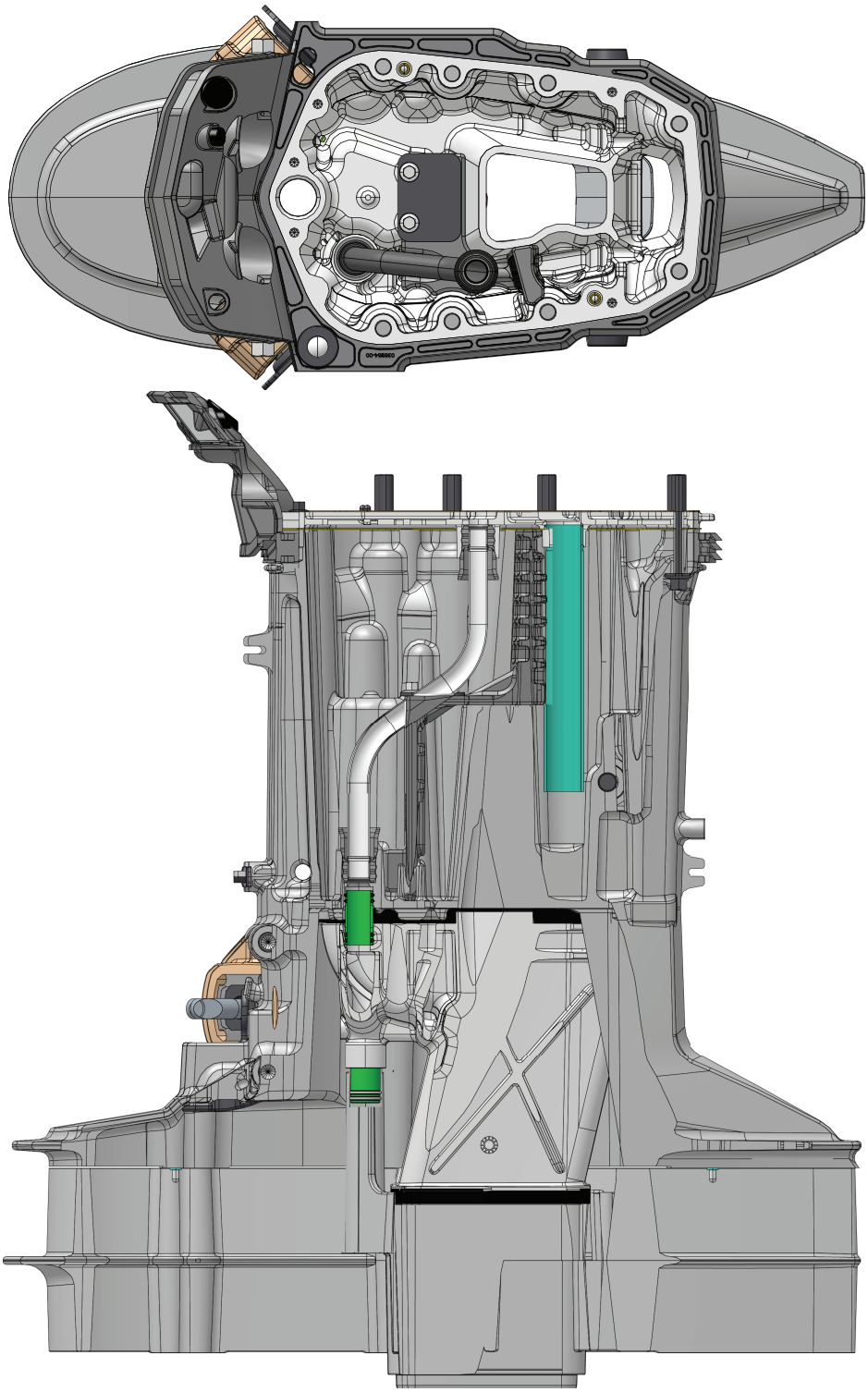
Service Charts: Exhaust Housing and Adapter Plate



C	Adhesive 847	***H***	Outboard Lubricant
X	See Service Manual procedure		

12

Reference Views



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Exhaust Housing Service

SERVICE TOOLS

Description	Part Number	Page
OETIKER PINCERS	P/N 350860	253

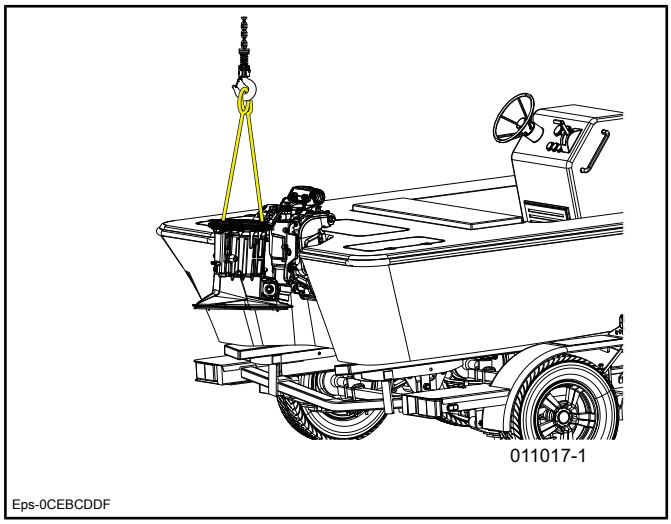
Exhaust Housing Removal

Remove the engine covers and frames. Refer to **Engine Cover and Frame Service**.

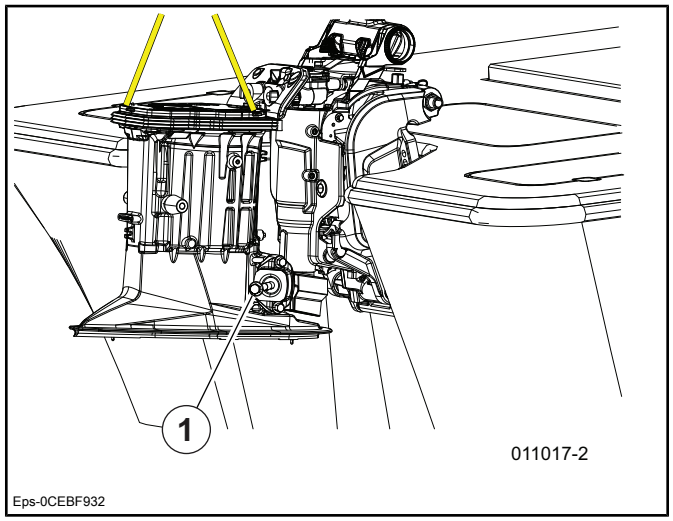
Remove the gearcase first. Refer to **Gearcase Removal**.

Remove the powerhead. Refer to **Powerhead Removal**.

1. Support the exhaust housing with appropriate straps from a hoist.

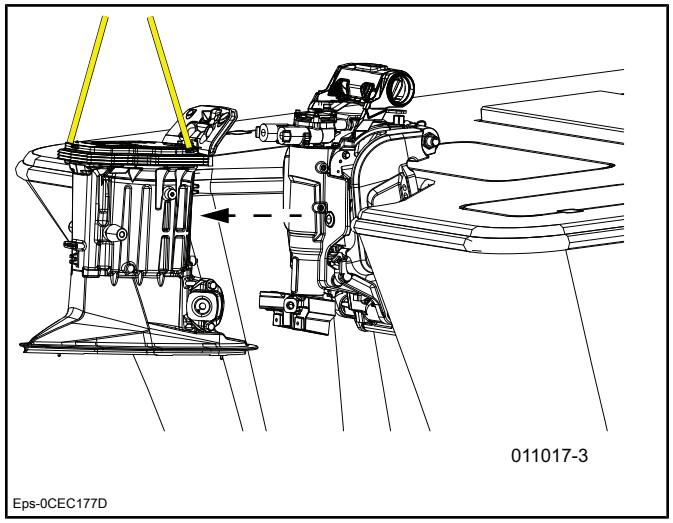


2. Remove the two lower mount screws.



1. Lower mount screw (Starboard side shown)

3. Remove the exhaust housing and adapter from the swivel bracket assembly.

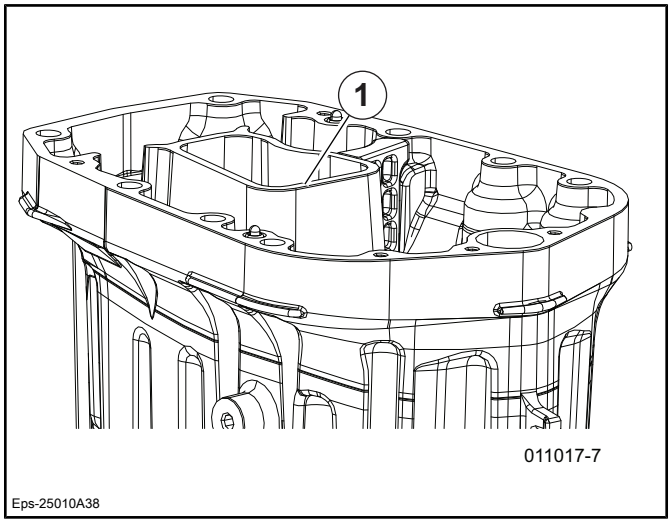


Cleaning and Inspection

⚠ WARNING

Wear safety glasses to avoid personal injury, and set compressed air pressure to less than 25 psi (172 kPa).

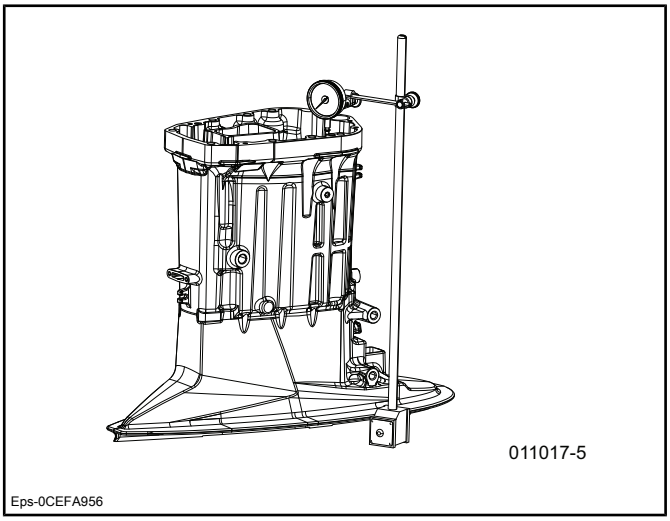
1. Clean all parts with parts cleaning solvent and dry with compressed air.
2. Thoroughly clean all nut and screw threads coated with thread locking material before assembly.
3. Examine the upper and lower mounts. Replace if deteriorated or damaged.
4. Remove the exhaust adapter.
5. Thoroughly clean the top and bottom mating surfaces and remove all sealer and any corrosion.
6. Inspect the top surface of the exhaust megaphone for melted material.



1. Top surface of exhaust megaphone

If the top surface of the megaphone surface is melted, replace the exhaust housing.

7. Place the exhaust housing on a surface plate.
8. Using dial indicator, check flatness by measuring run out on the to edge of the housing.

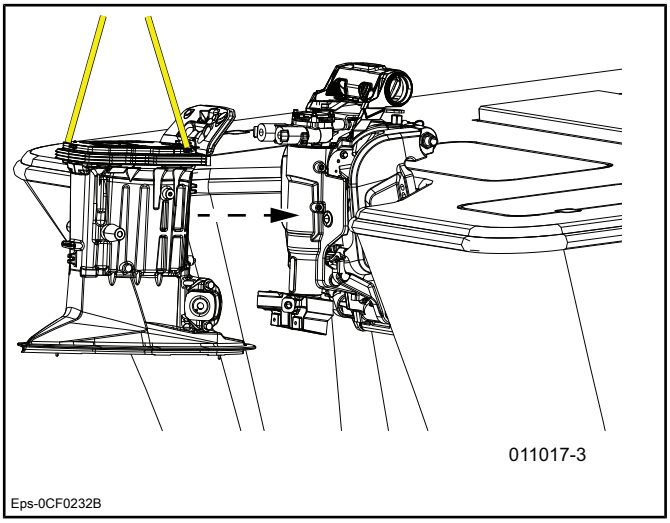


The maximum allowable run out is 0.009 in. (0.228 mm).

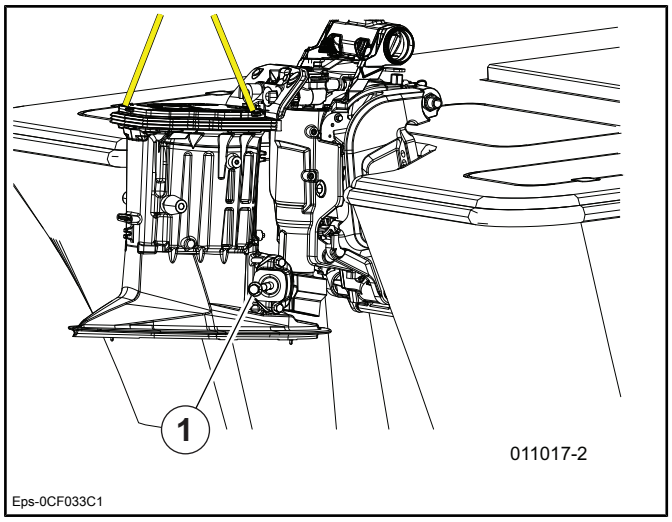
IMPORTANT: If you do not have access to a dial indicator and surface plate, seek the services of a machine shop. Do NOT attempt to straighten a distorted housing. Replace it. A distorted exhaust housing will cause the upper driveshaft splines to wear excessively and will damage the crankshaft splines.

Exhaust Housing Installation

1. Align the exhaust housing and adapter onto the swivel bracket assembly.



2. Install the two upper mount screws. Install the two lower mount screws.
3. Tighten the upper mount nuts to a torque of 57 to 59 Ft. lbs. (77.3 to 79.9 N·m). Tighten the lower mount screws to a torque of 79 to 81 Ft. lbs. (107 to 110 N·m).



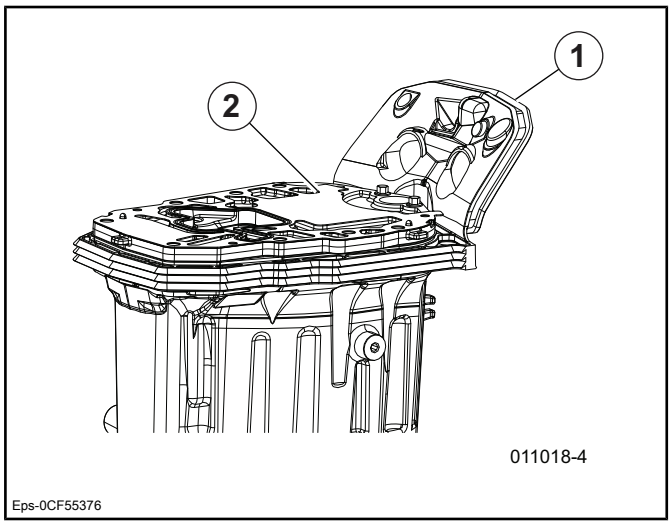
1. Lower mount screw (Starboard side shown)

4. Remove the supporting strap from the exhaust housing.
5. Install the powerhead. Refer to **Powerhead Installation**.
6. Install the gearcase. Refer to **Gearcase Installation**.

Exhaust Adapter Plate Removal

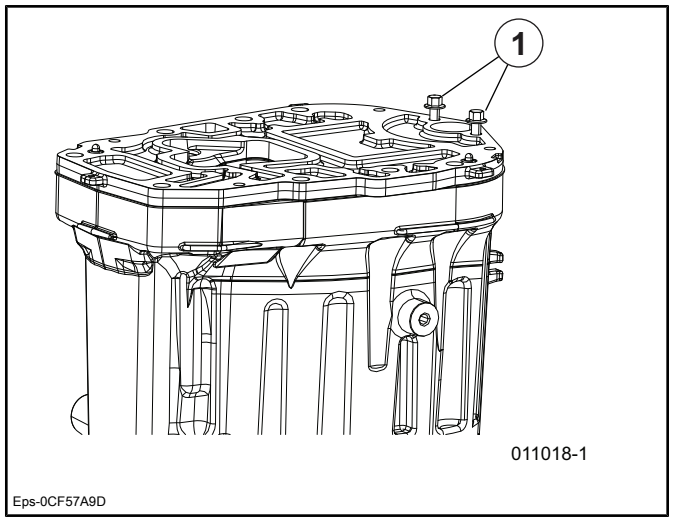
Removing the exhaust adapter plate requires removing the powerhead. Refer to **Powerhead Removal**.

1. Carefully remove the foam perimeter seal from the adapter.
2. Remove the powerhead to adapter gasket from the adapter.



1. Perimeter seal
2. Gasket

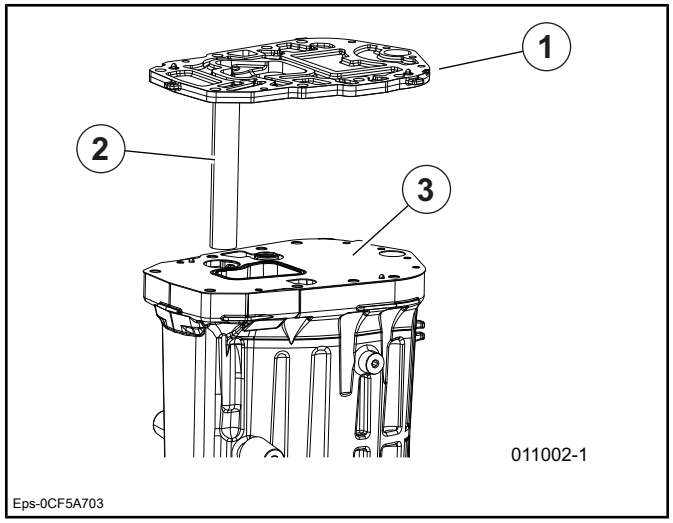
3. Remove the two screws from the exhaust adapter plate.



1. Two screws

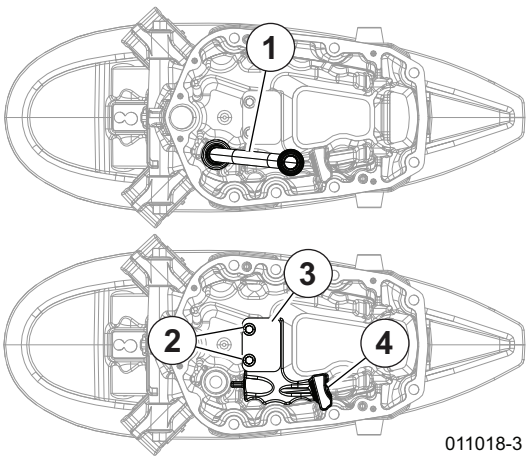
4. Use an appropriate tool to CAREFULLY pry up on and remove the adapter plate. Then remove the gasket.

   Typically the exhaust relief tube will remain attached to the adapter plate.



1. Exhaust adapter plate
2. Exhaust relief tube
3. Gasket

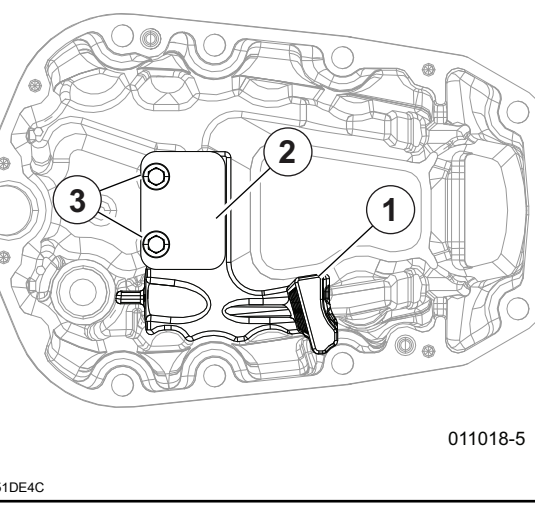
5. If needed, remove the water tube with two grommets. Then remove two screws and retainer plate, followed by the exhaust baffle.



1. *Water tube and grommets*
2. *Two screws*
3. *Retainer plate*
4. *Baffle*

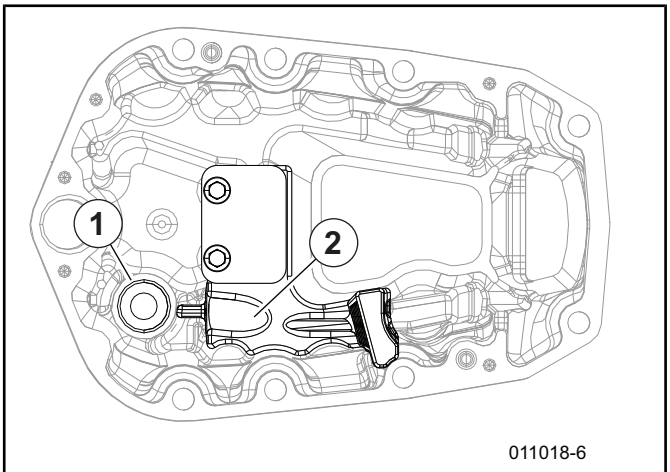
Exhaust Adapter Plate Installation

1. Install the exhaust baffle into the exhaust housing.
2. Install the retainer plate with two screws. Tighten the screws to a torque of 84 to 106 In. lbs. (9.5 to 12 N·m).

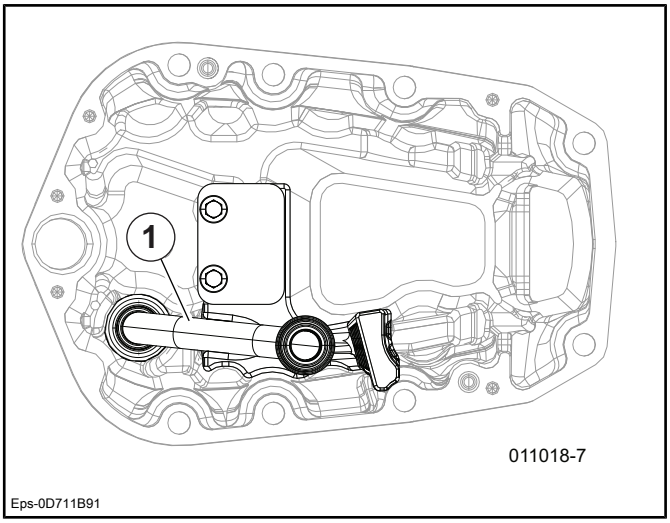


1. *Baffle*
2. *Retainer plate*
3. *Two screws*

3. Apply soapy water to the grommets. The water tube is symmetrical, install either end into the water passage. Align the water tube so the lower bend rests in the pocket of the exhaust baffle. This will align the upper grommet of the water tube with the exhaust adapter plate.

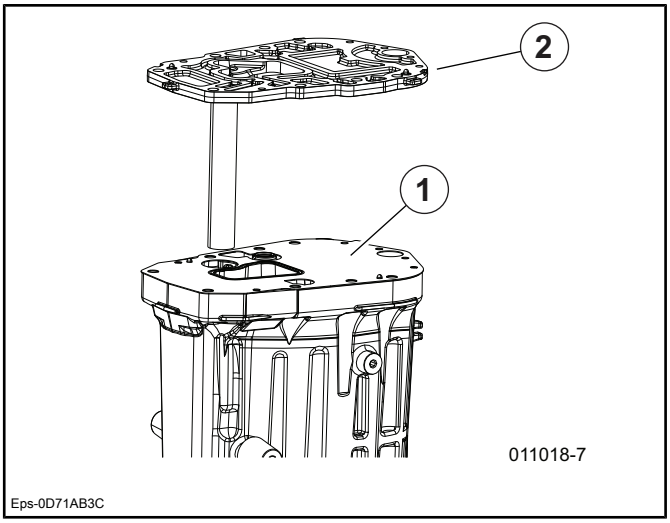


1. *Water passage*
2. *Exhaust baffle pocket*



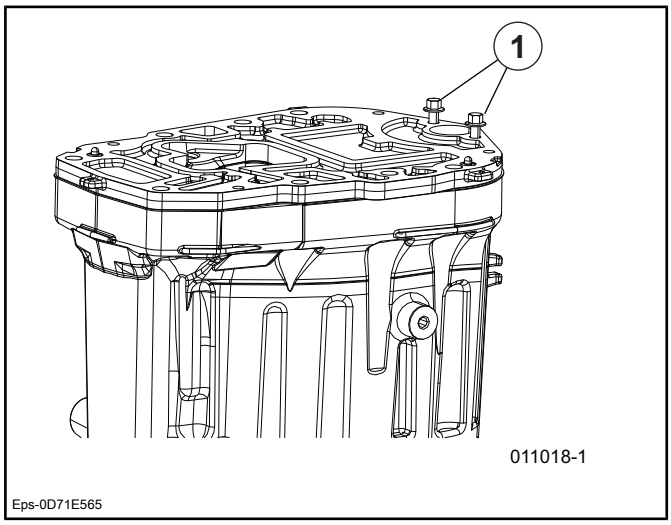
1. *Water tube installed*

4. Apply soapy water to the water tube grommet.
5. Install a new gasket on the exhaust housing
6. Install the exhaust adapter plate and idle relief tube, aligning the water passage of the adapter plate with the water tube.



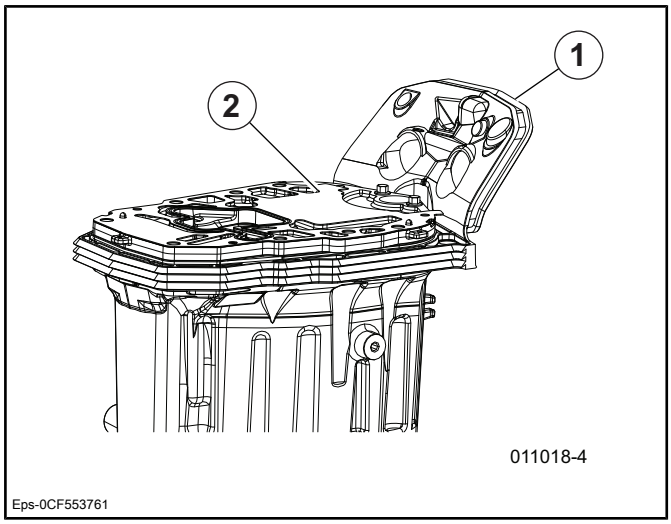
1. *Gasket*
2. *Exhaust adapter plate*

7. Install the two screws and tighten to a torque of 84 to 106 In. lbs. (9.5 to 12 N·m).



1. Screws

8. Carefully install the perimeter seal gasket onto the adapter.
9. Install a new gasket onto the adapter.



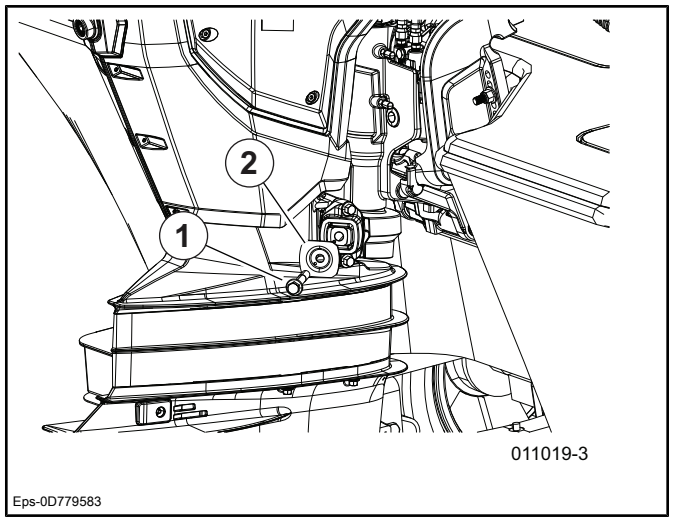
1. Perimeter seal
2. Gasket

Install the powerhead. Refer to **Powerhead Installation**.

Lower Mount Service

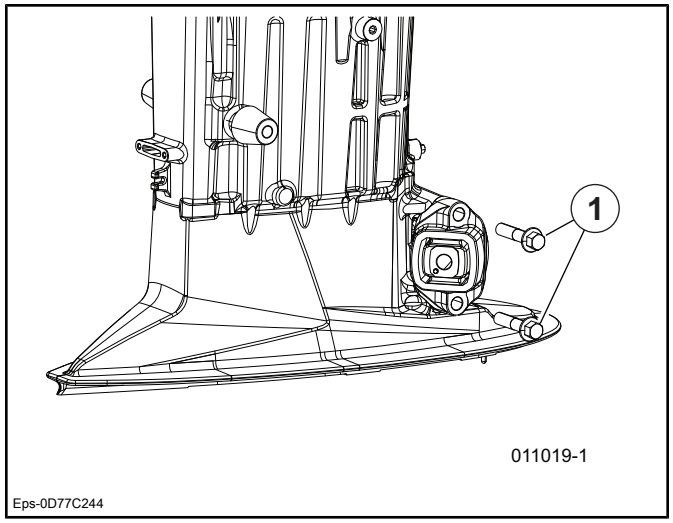
NOTE: It is NOT necessary to remove the exhaust housing and adapter from the swivel bracket to service the lower mounts.

1. Remove the screw and cover from the lower mount.



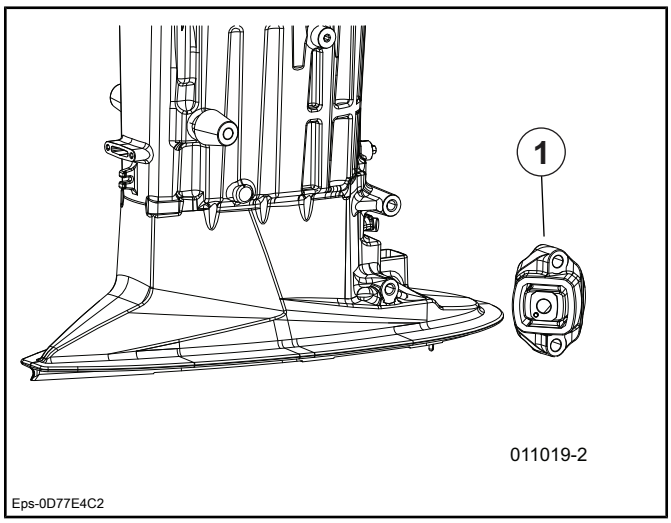
1. Screw
2. Cover

2. Inspect the mount.
3. If replacement is necessary, remove the two screws from the lower mount.



1. Screws

4. Remove the mount from the exhaust housing.



1. Mount

5. Installation is the reverse of removal.
6. Install the two screws into the mount. Tighten the two screws to a torque of 52 to 54 Ft. lbs. (70.5 to 73.2 N·m).
7. Install the mount cover and screw. Tighten to a torque of 79 to 81 Ft. lbs. (107 to 110 N·m).

Exhaust Relief Muffler Assembly

The exhaust relief muffler is located on the port side of the outboard and is concealed by the engine covers and frames.

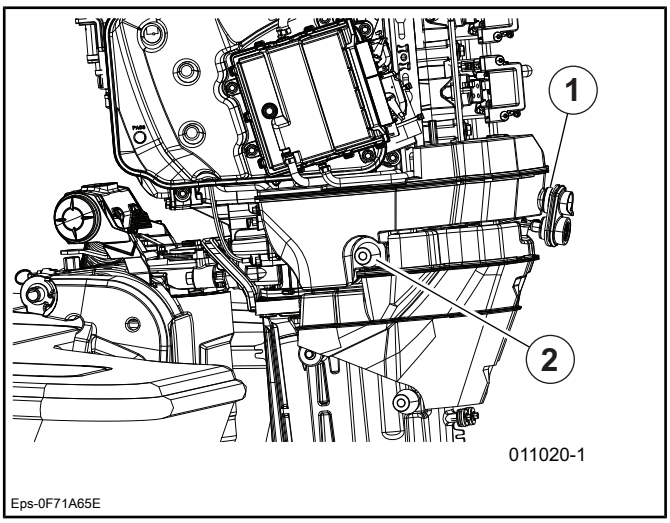
The exhaust relief grommet connects directly to the muffler assembly. The muffler assembly connects to an exhaust fitting on the port side of the engine block.

Exhaust Relief Muffler Service

Servicing the exhaust relief muffler requires removal of the engine top cover, starboard and port frames. Refer to **Engine Cover and Frame Service**.

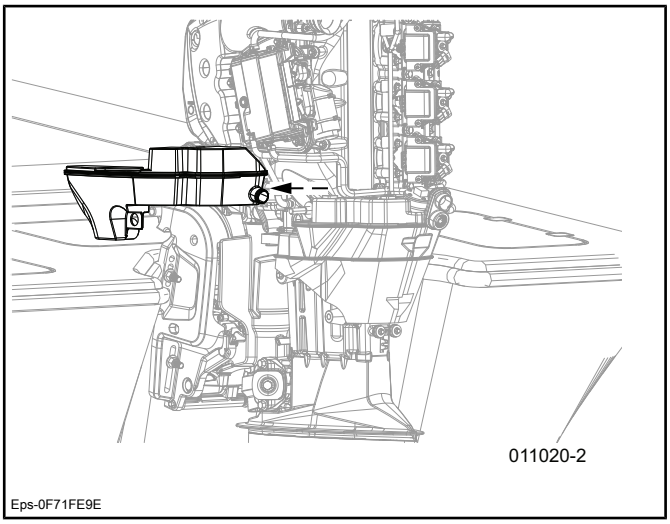
Removal

1. Make not of the orientation of the ear of the clamp BEFORE removal. Then remove the clamp retaining the exhaust relief grommet to the muffler assembly
2. Remove the rubber mount and washer from the muffler assembly.



1. Clamp
2. Mount and washer

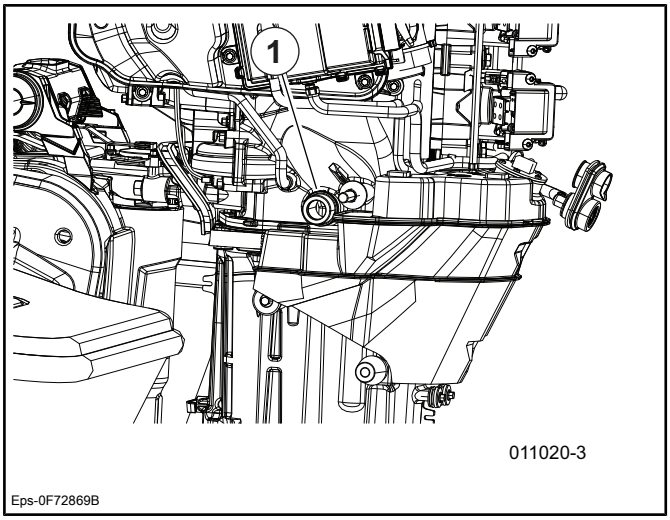
3. Carefully work the muffler away from the engine block to remove. Do NOT pry against the oil tank.



Installation

Installation is the reverse of removal.

4. Inspect the muffler grommet BEFORE installing the muffler. Replace the grommet if damaged.
5. Lubricate the muffler grommet with soapy water.

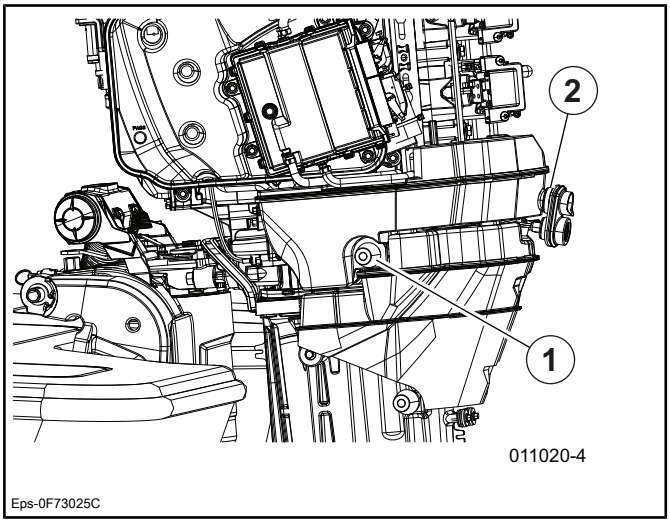


1. Muffler grommet

6. Install the muffler onto the engine.
7. Install the washer and rubber mount.

Required Tool
***Oetiker* Pincers** **P/N 350860**

8. Install the exhaust relief grommet onto the muffler assembly with a new *Oetiker* clamp. Orient the ear of the clamp as previously noted and use *Oetiker* pincers, P/N 350860 to secure the clamp.



1. Washer and mount
2. Clamp

Install the frames and engine covers. Refer to **Engine Cover and Frame Service**.

Notes

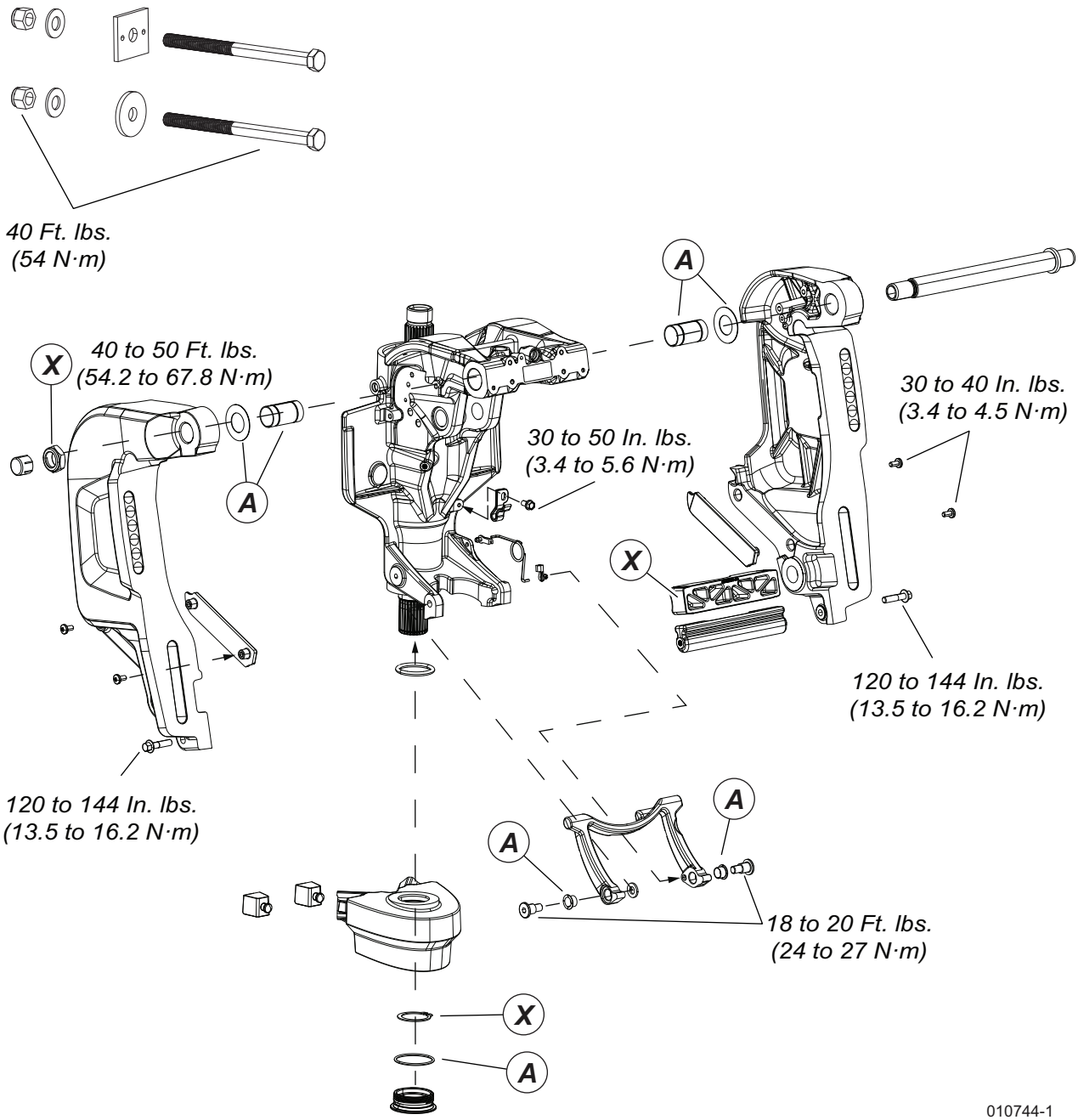
Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

Stern and Swivel

Service Charts: Stern Brackets



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A	*Triple Guard* grease	***X***	See Service Manual procedure

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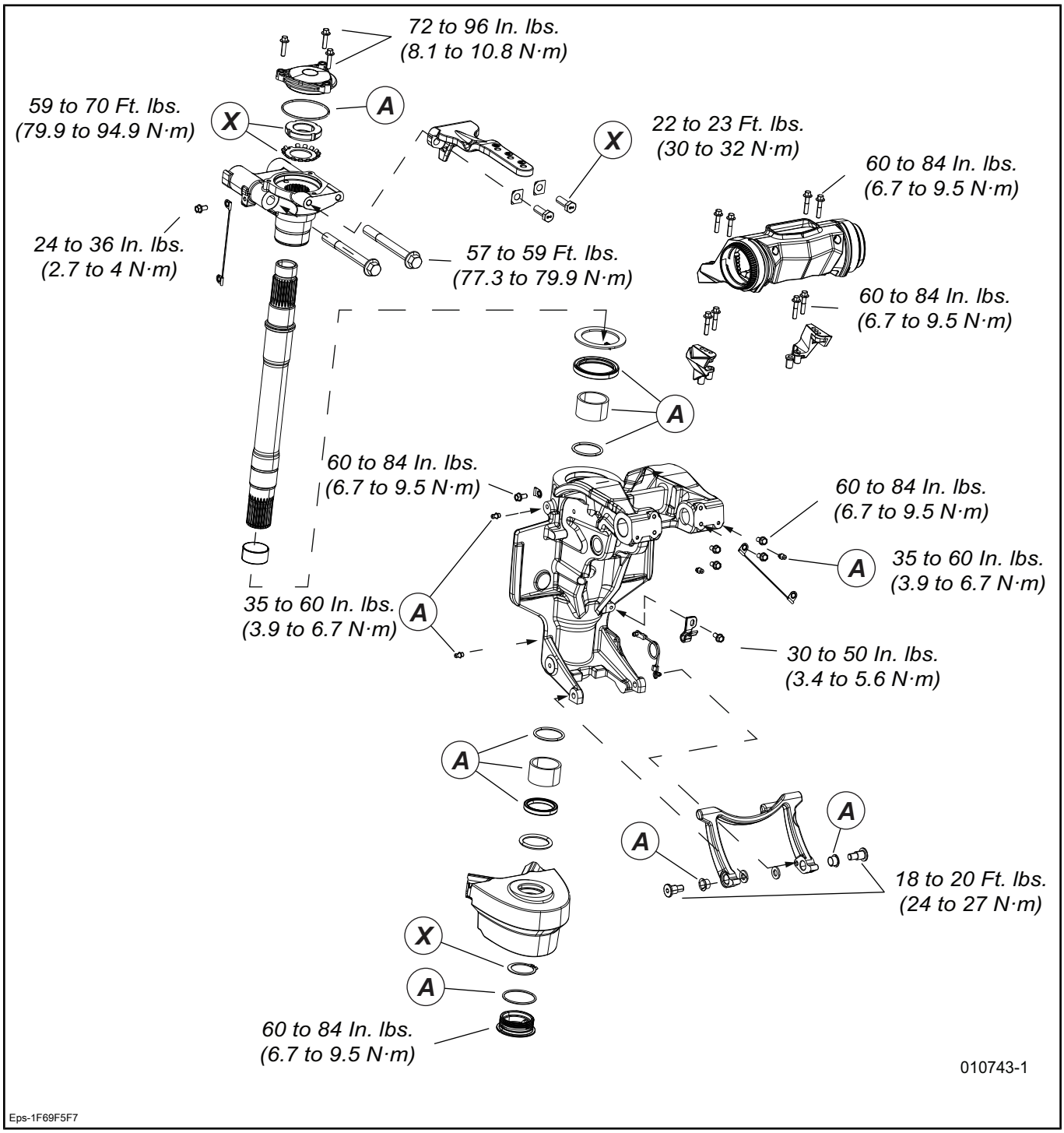
Service Charts: Non-DPS Swivel Bracket



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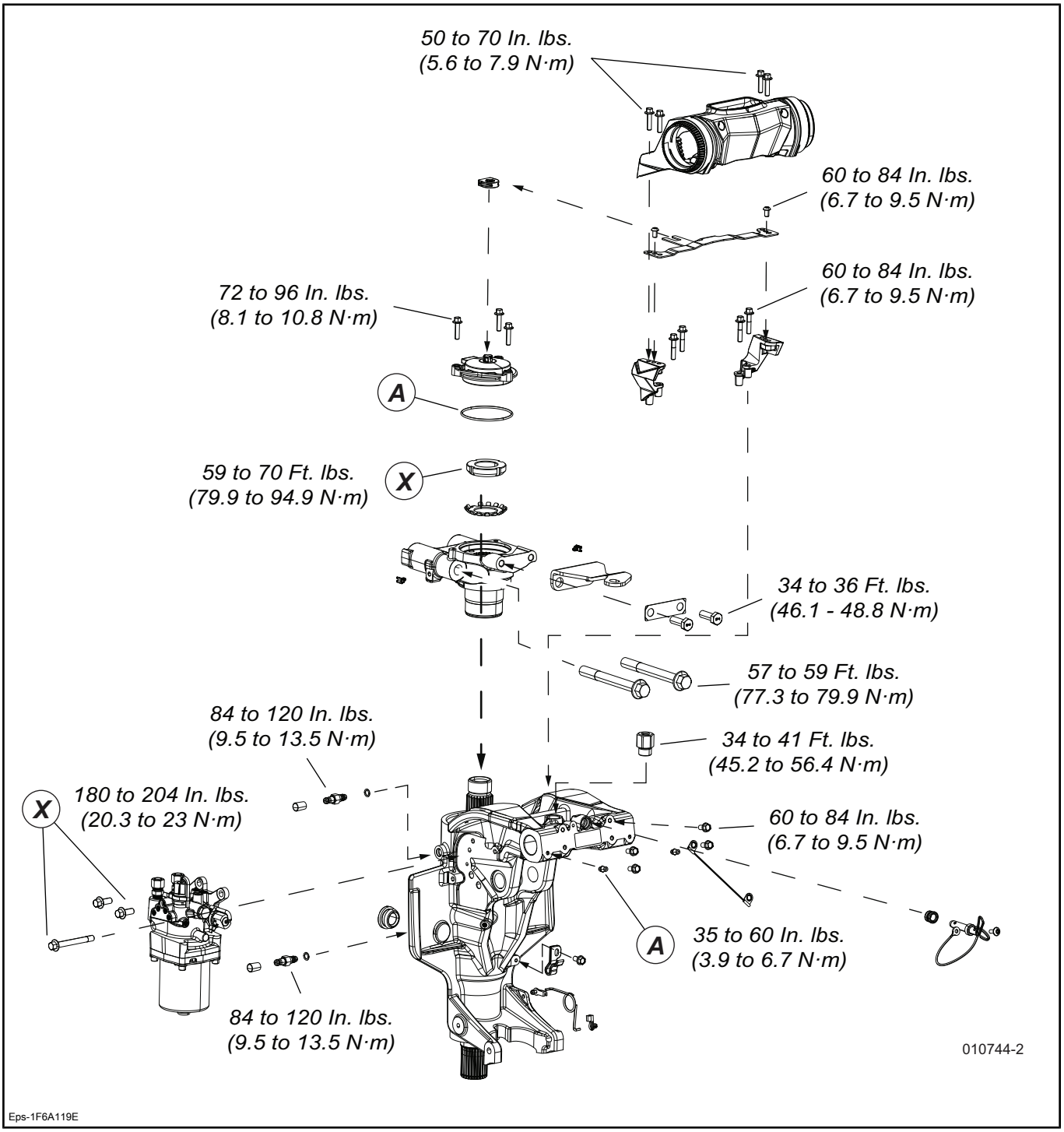
A	*Triple Guard* grease	***X***	See Service Manual procedure

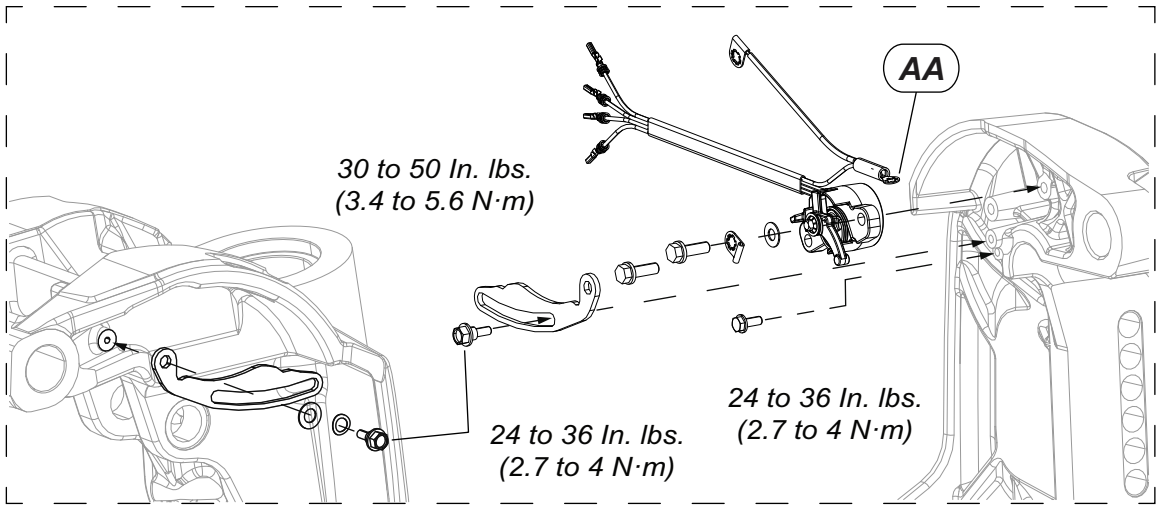
Service Charts: DPS Swivel Bracket

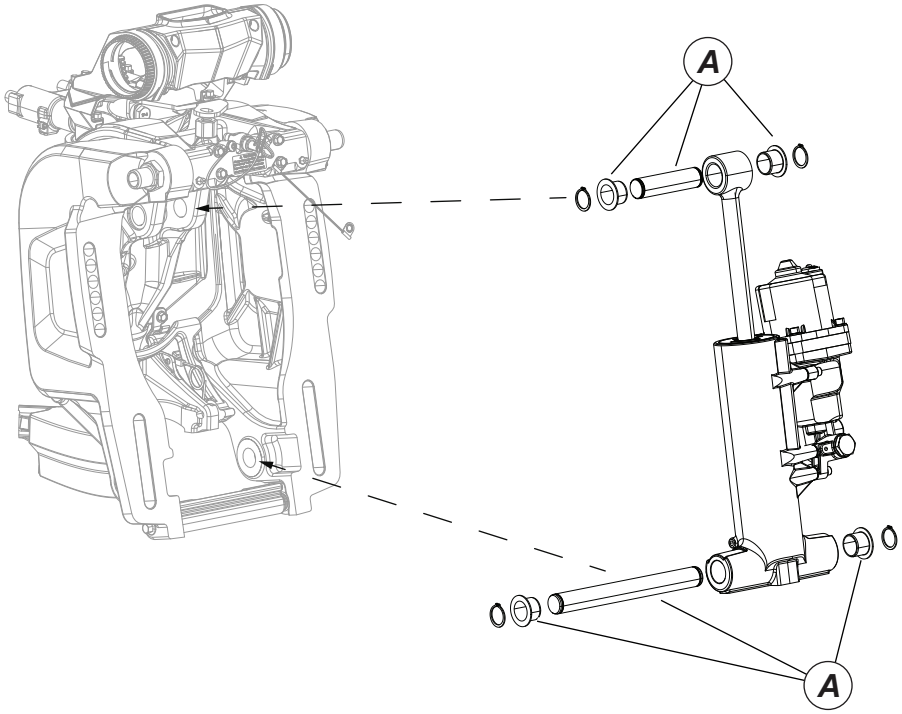


A	*Triple Guard* grease	***X***	See Service Manual procedure

13

Service Charts: Trim & Tilt Assembly





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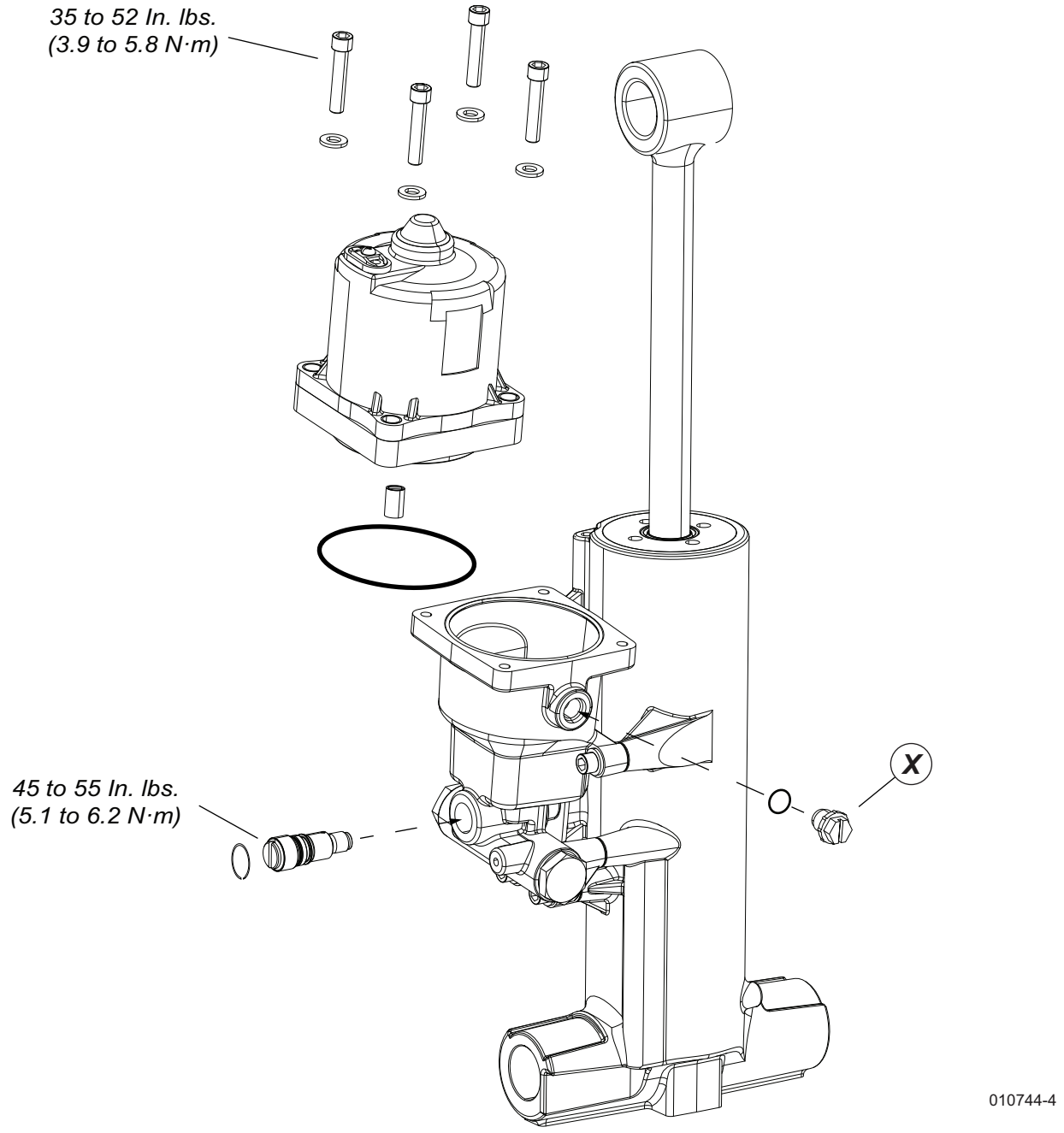
A	*Triple Guard* grease	***AA***	*No-Ox* grease



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A	*Triple Guard* grease	***X***	See Service Manual procedure

Dynamic Power Steering

The DPS system consists of a hydraulic steering helm, hydraulic hoses, hydraulic fluid, the DPS module, and a hydraulic DPS steering pump assembly.

The DPS module monitors and controls the DPS system. The *EMM* monitors the DPS module, stores fault codes and activates the engine monitor should a fault code be generated.

Also refer to the **DPS Troubleshooting Tables** and **Fault Code Table** at the end of this manual.

If the DPS motor circuit is OPEN, the *EMM*:
– Stores fault code 211
– Engine Monitor: CHECK ENGINE display ON

If DPS motor current exceeds allowed limit, the *EMM*:
– Stores fault code 216
– Engine Monitor: CHECK ENGINE display ON

If DPS module supply voltage is less than 5 volts, the *EMM*:
– Stores fault code 217
– Engine Monitor: CHECK ENGINE display ON

If DPS module temperature exceeds 176° F (80° C), the *EMM*:
– Stores fault code 218
– Engine Monitor: CHECK ENGINE display ON

DPS

The DPS system includes port and starboard helm pressure sensors and a steering position sensor.

As the steering wheel is turned hydraulic fluid in the helm begins moving through the steering system.

One helm pressure sensor signals the DPS module of an increase in hydraulic pressure in the direction of the turn. When DPS module detects an approximate 12 psi (82 kPa) pressure differential between the two pressure sensors, it turns ON the DPS pump providing steering assistance.

The DPS module also monitors the steering position sensor. As the outboard approaches the steering system stop, the DPS module turns OFF the DPS pump to maximize system efficiency.

The DPS Module monitors Port Pressure Sensor (PTPS) voltage and Starboard Pressure Sensor (STPS) voltage.

If PTPS voltage is less than 0.12 V, the *EMM*:
– Stores fault code 212
– Engine Monitor: CHECK ENGINE display ON

If PTPS voltage is greater than 4.6 V, the *EMM*:
– Stores fault code 213
– Engine Monitor: CHECK ENGINE display ON

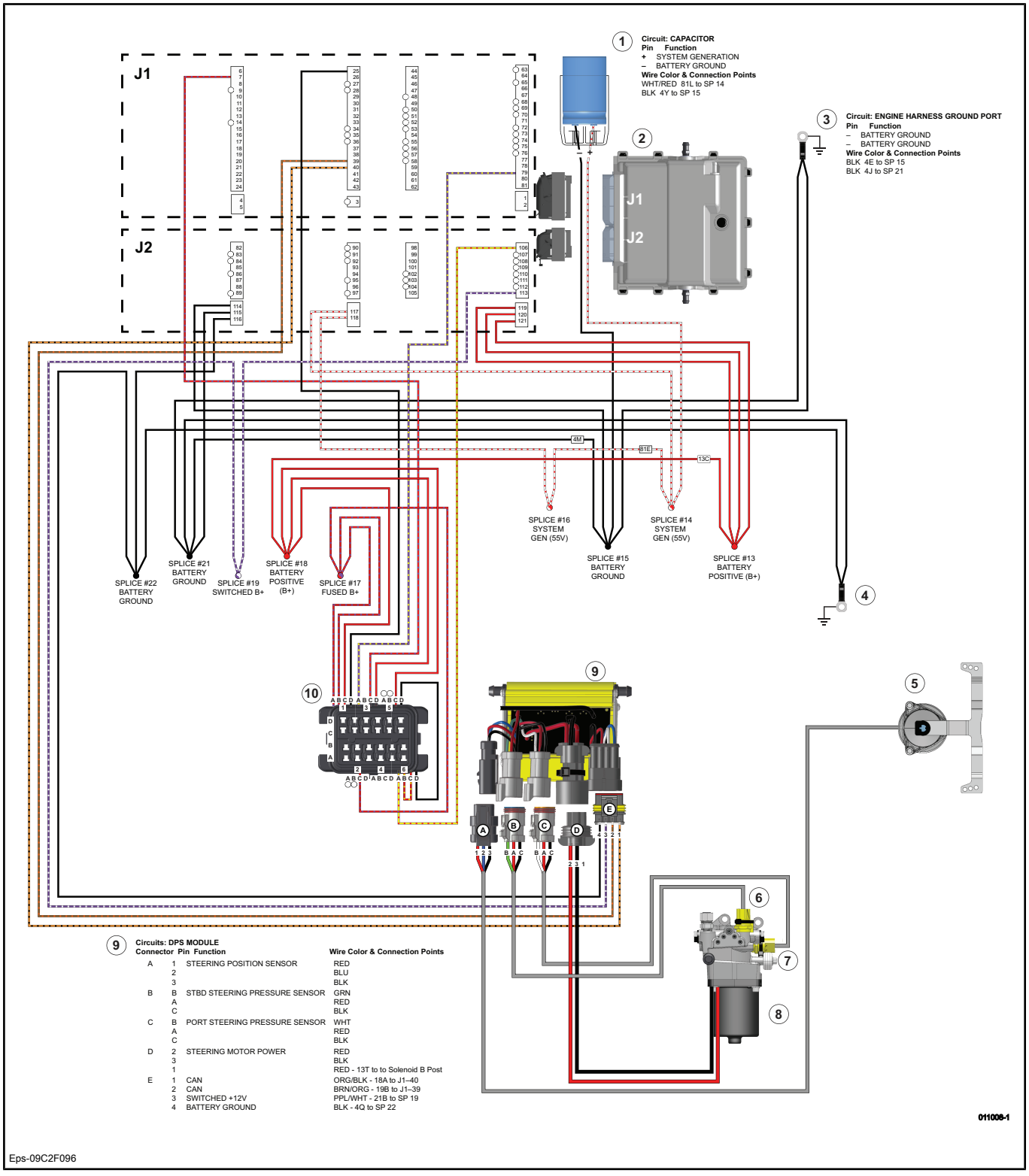
If STPS voltage is less than 0.12 V, the *EMM*:
– Stores fault code 214
– Engine Monitor: CHECK ENGINE display ON

If STPS voltage is greater than 4.6 V, the *EMM*:
– Stores fault code 215
– Engine Monitor: CHECK ENGINE display ON

If Steering Sensor (STS) voltage is less than 0.12 V, the *EMM*:
– Stores fault code 220
– Engine Monitor: CHECK ENGINE display ON

If STS voltage is greater than 4.88 V, the *EMM*:
– Stores fault code 221
– Engine Monitor: CHECK ENGINE display ON

DPS Electrical Circuit Diagram



Eps-09C2F096

Legend	
B +	Battery Positive
B –	Battery Negative (ground)
BLK	Black
BLU	Blue
BRN	Brown
CAN	Controller Area Network
GND	Ground
GRN	Green
GRY	Gray
J1	EMM J1 Connector
J2	EMM J2 Connector
ORG	Orange
PNK	Pink
PPL	Purple
RED	Red
SP	Splice
TAN	Tan
WHT	White
YEL	Yellow

Component List	
1	Capacitor
2	*EMM*
3	Engine Harness Ground (Port)
4	Engine Harness Ground (Starboard)
5	Steering Position Sensor
6	PORT Steering Pressure Sensor
7	STARBOARD Steering Pressure Sensor
8	Steering Motor
9	DPS Control Module
10	Fuse Panel

Fuse Panel Pinouts

Pin	Function	Wire Color and Connection Points
1A	Fused B+	RED/PPL 41G to SP 17
1B	Fused B+	RED/PPL 41H to SP 17
1C	B+	RED 13Q to SP 18
1D	Battery Ground (–)	BLK 4F to J1–44
2A	Empty	–
2B	Empty	–
2C	Fused B+	RED/PPL 41F to SP 17
2D	Battery Ground (–)	BLK 4DD to SP 7
3A	Switched B+ to 55V Relay In	PPL/YEL 20D to J1–79
3B	Switched B+ to 55V Relay Out	PPL/WHT 21A to SP 19
3C	Fused B+	RED/PPL 41M to J1–26
3D	B+ *EMM*	RED 13R to SP 18
4A	Relay KL87 (Output)	RED/TAN 80B to Start Solenoid
4B	Relay KL86 (Control +)	RED/PPL 41E to SP 12
4C	Fused Helm Power	RED/YEL 74B to SP 2
4D	Fused B+	RED/PPL 41B to SP 12
5A	Empty	–
5B	Empty	–
5C	B+ (Start Solenoid)	RED 13P to SP 18
5D	Spare	BLK 4CA to Fuse Block 6D
6A	Relay KL85 (Control –)	YEL/RED 25A to J2–106
6B	Relay KL 30 (Supply to)	RED/YEL 74C to Fuse Block 6C
6C	Fused Helm Power	RED/YEL 74C to Fuse Block 6B
6D	Spare	BLK 4CA to Fuse Block 5D

DPS System Tests

DPS System Function Test

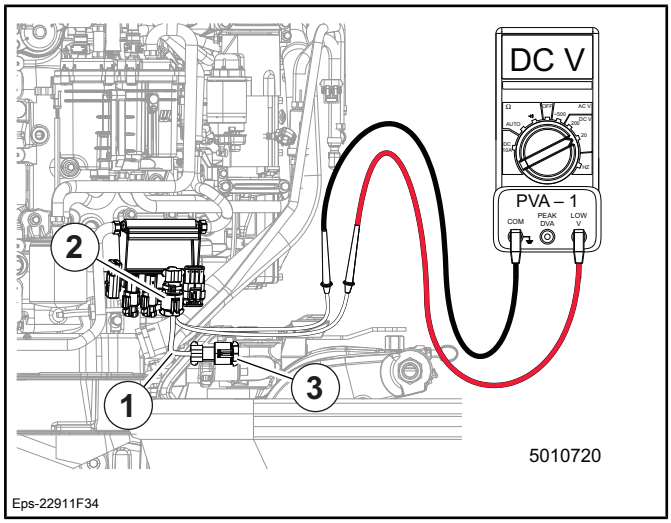
The output of the DPS module is Pulse Width Modulated (PWM). Use the DPS Test Lead, P/N 5010720, and a Peak Reading Voltmeter such as a Stevens CD-77, or a Digital Multimeter with a DVA Adapter, such as a Stevens PVA-1, to check the DPS module output.

Install the test lead between the DPS module and the DPS motor cable.

Connect the meter leads to the DPS Test Lead, P/N 5010720. Connect the positive meter lead to the red lead. Connect the negative meter lead to the black lead. If using a Stevens CD-77, set to “POS” and “50”.

If using a digital multimeter, turn the multimeter on. Set as recommended by the instructions for the DVA adapter. Select a voltage range that will read a minimum of 12 volts.

If using a Stevens PVA-1 set the multimeter to “DC Volts”. Select a voltage range that will read a minimum of 12 volts.



1. *DPS Test Lead, P/N 5010720*
2. *DPS module*
3. *DPS motor cable*

Turn the key switch to the ON position.

Turn the steering wheel in a smooth even motion and observe the voltage reading.

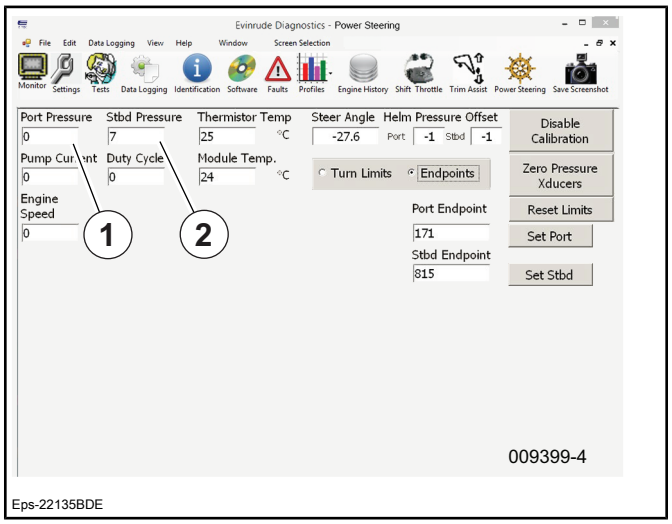
IMPORTANT: Turning the steering wheel erratically will result in erratic voltage readings. Any result ABOVE 0.0 volts indicates output from the module.

Results

If test results indicate output from the DPS module (12V approximately), the DPS module is good. Check wiring and test the DPS steering motor. If test results indicate no output (0.0 volts) from the DPS module, additional troubleshooting is required.

If no voltage output is observed use the “Power Steering” tab of *Evinrude Diagnostics* software v 6.4 or higher, as follows:

Monitor the PORT and STARBOARD pressures while steering the outboard. Confirm a 12 psi (82.7 kPa) difference between PORT and STARBOARD pressures, which is required to activate the DPS motor.

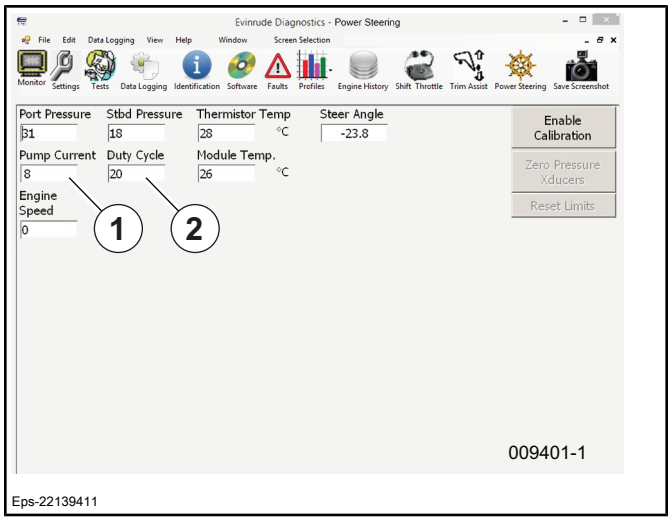


1. *PORT pressure*
2. *STARBOARD pressure*

If a 12 psi (82.7 kPa) difference is present, observe the Pump Current and Duty Cycle.

Result

If the Duty Cycle increases but the Pump Current remains at 0, replace the DPS Module.



Eps-22139411

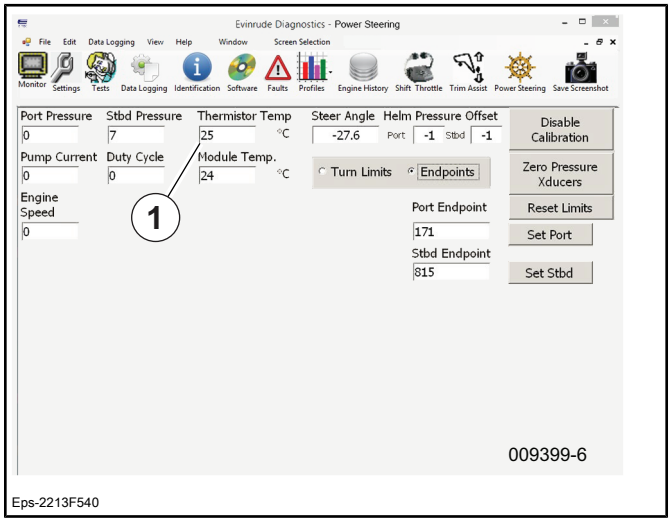
1. *Pump Current*
2. *Duty Cycle*

Confirm the DPS Module Thermistor Temp is less than 150ºF (66°C).

Result

If the Thermistor Temp is greater than 150ºF (66° C) the system has de-rated to the point which it no longer will function.

If the Thermistor Temp is greater than 150ºF (66° C) immediately after powering up the system, replace the DPS Module.



Eps-2213F540

1. *Thermistor Temp*

DPS Module

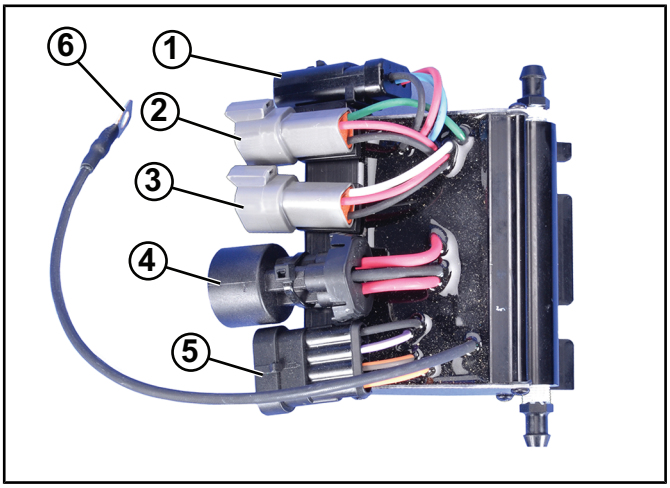
NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Leads from the test probe kit can be repaired, or custom test leads can be made locally if needed. Refer to **Electrical Testing**.

The DPS module circuits can be tested on or off the outboard.

Disconnect the battery cables at the battery. Disconnect the electrical connectors from the DPS module.



DPS MODULE CONNECTORS

1. *Steering position*
2. *Pressure sensor 2*
3. *Pressure sensor 1*
4. *Steering motor*
5. *CANbus communication*
6. *Ground (to port engine ground screw)*

Steering Ground Circuits

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Connect the positive meter lead to the DPS Module connector/ wire listed in the table.

Connect the negative meter lead to engine ground.

DPS Module Ground Circuit		
Connector/Wire	**Pin**	**Result**
Steering Position/Black	3	< 1 Ω
Pressure Sensor 2 / Black	C	
Pressure Sensor 1 / Black	C	

Results:

- Readings as listed in table indicate circuit is good
- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Replace faulty module.

Steering Supply Circuits

Use the diode test function of a digital multimeter to check the supply circuits.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

DPS Module Steering Supply Circuit (Diode Test)		
Connector/Wire	**Pin**	**Result**
Steering Position / Red	1	approximately 0.5 VDC
Pressure Sensor 2 / Red	A	
Pressure Sensor 1 / Red	A	
Steering Motor / Red	2	1.2 to 1.4 VDC
Steering Motor / Red	1	1.4 to 1.55 VDC

Results:

- Readings as listed in table indicate circuit is good
- No reading (OL or ∞) indicates an open circuit
- A reading of zero (0) indicates an short circuit.

Replace faulty module.

Steering Sensor Circuits

Use the diode test function of a digital multimeter to check the signal circuit.

Connect the BLACK meter lead to the wire listed in the table, connect the RED meter lead to engine ground.

DPS Module Sensor Circuits (Diode Test)		
Connector/Wire	**Pin**	**Result**
Steering Position / Blue	2	approximately 0.5 VDC
Pressure Sensor 2 / Green	B	
Pressure Sensor 1 / White	B	

Results:

- Readings as listed in table indicate circuit is good.
- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Replace faulty module.

CANbus Circuit

Use a digital multimeter with appropriate test probe leads to measure sensor circuit resistance.

Connect the positive meter lead to the DPS Module connector/ wire listed in the table.

Connect the negative meter lead to engine ground.

CANbus Circuit Resistance Test		
Connector/Wire	**Pin**	**Result**
CAN (Orange/Black)	1	120 Ω
CAN (Brown/Orange)	2	
CAN (Purple/White)	3	N/A
CAN (Black)	4	< 1 Ω

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Replace faulty module.

Steering Pressure Sensor Tests

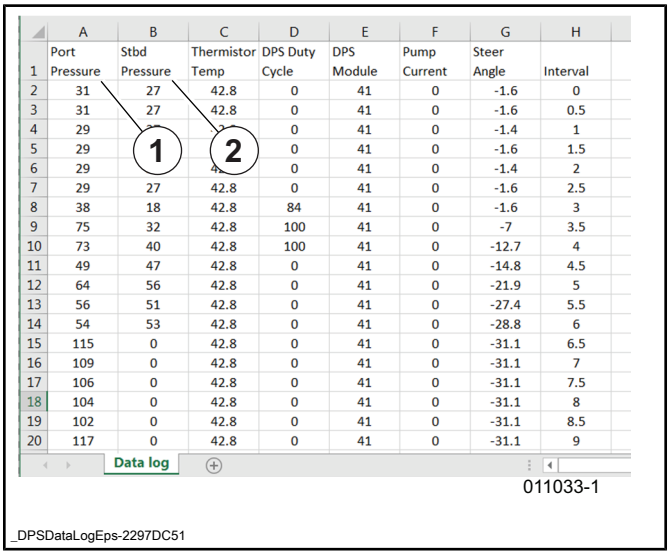
Use the DPS tab in the Data Log feature of *Evinrude Diagnostics* software v 6.4 or higher to monitor *Port Pressure* and *Starboard Pressure.*

Turn the steering wheel fully to STARBOARD. Then turn the steering wheel to PORT at a smooth consistent rate until it contacts the stop. Hold the steering wheel against the stop, and continue to apply pressure until the pressure relief valve of the helm activates and the steering wheel turns slightly.

Next turn the steering wheel to STARBOARD at a smooth consistent rate until it contacts the stop. Hold the steering wheel against the stop, and continue to apply pressure until the pressure relief valve of the helm activates and the steering wheel turns slightly.

Review the data log information.

Helm pressure should rise as the steering wheel is turned and peak as the steering wheel contacts the stop. Pressure will spike and then drop as the pressure relief valve of the helm is activated. Maximum pressure can be up to approximately 1000 psi (6895 kPa) for a standard helm, or 1500 psi (10342 kPa) for a *Pro-Series* or *SVS-Series* helm.

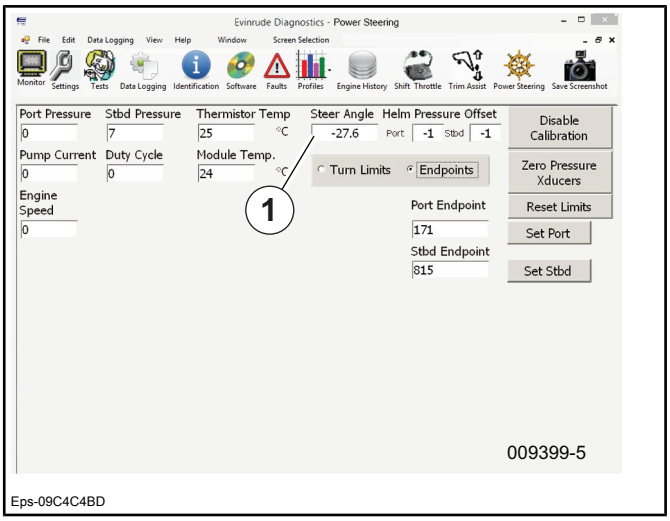


	A	B	C	D	E	F	G	H
1	Port Pressure	Stbd Pressure	Thermistor Temp	DPS Duty Cycle	DPS Module	Pump Current	Steer Angle	Interval
2	31	27	42.8	0	41	0	-1.6	0
3	31	27	42.8	0	41	0	-1.6	0.5
4	29			0	41	0	-1.4	1
5	29			0	41	0	-1.6	1.5
6	29			0	41	0	-1.4	2
7	29	27	42.8	0	41	0	-1.6	2.5
8	38	18	42.8	84	41	0	-1.6	3
9	75	32	42.8	100	41	0	-7	3.5
10	73	40	42.8	100	41	0	-12.7	4
11	49	47	42.8	0	41	0	-14.8	4.5
12	64	56	42.8	0	41	0	-21.9	5
13	56	51	42.8	0	41	0	-27.4	5.5
14	54	53	42.8	0	41	0	-28.8	6
15	115	0	42.8	0	41	0	-31.1	6.5
16	109	0	42.8	0	41	0	-31.1	7
17	106	0	42.8	0	41	0	-31.1	7.5
18	104	0	42.8	0	41	0	-31.1	8
19	102	0	42.8	0	41	0	-31.1	8.5
20	117	0	42.8	0	41	0	-31.1	9

1. *Port Pressure*
2. *Starboard Pressure*

Steering Position Sensor Test

Use *Evinrude Diagnostics* software v 6.4 or higher to observe steering angle while turning the steering wheel.



1. *Steering Angle*

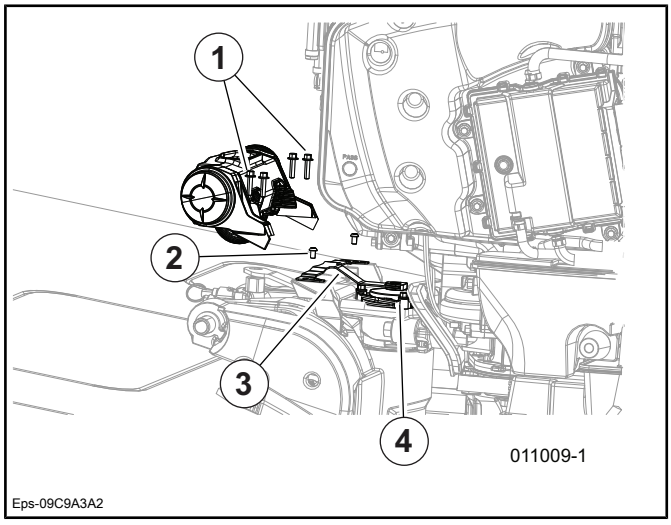
Steering Position Sensor Service

Steering Position Sensor Removal

Removal

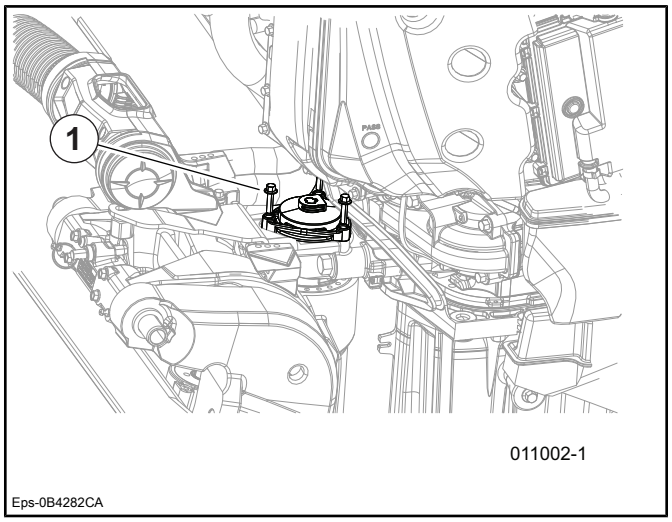
IMPORTANT: Review this section BEFORE beginning any work. It is NOT necessary to completely de-rig the outboard.

1. Disconnect the battery cables at the battery.
2. Remove the top cover, then the starboard and port frame. Refer to **Engine Cover and Frame Service**.
3. Disconnect the steering position sensor from the control module. Note the routing of sensor electrical harnesses. Use a digital camera to take a reference photo, if needed.
4. Remove the four screws retaining the rigging housing. Move the rigging housing forward.
5. Remove the two screws retaining the steering position sensor bracket.
6. Slide the steering position sensor bracket forward to remove it from the steering position sensor.



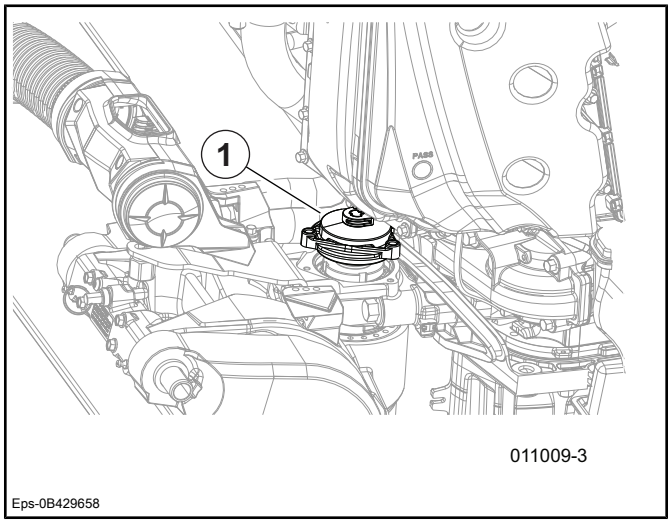
1. Four screws retaining rigging housing
2. Two Screws
3. Steering position sensor bracket
4. Steering position sensor

7. Remove the three screws from the steering position sensor. To ease access to the screws, turn the outboard to PORT or STARBOARD as needed.



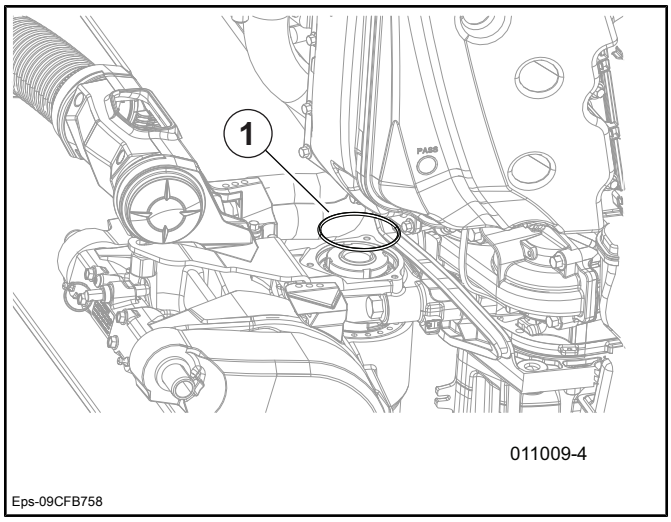
1. Three screws

8. Use an appropriate tool to remove the steering position sensor from the upper steering bracket.



1. Steering position sensor

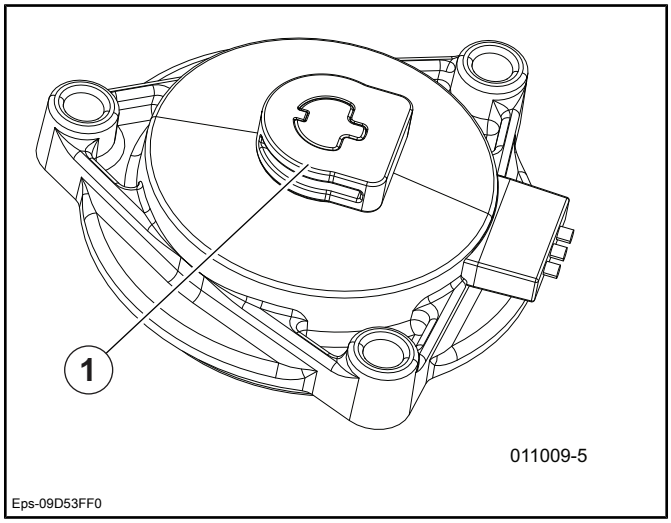
9. Remove the o-ring from the upper steering bracket if it didn't come off with the steering position sensor.



10. Remove the grommet from the steering position sensor. Save the grommet for installation on the new steering position sensor.

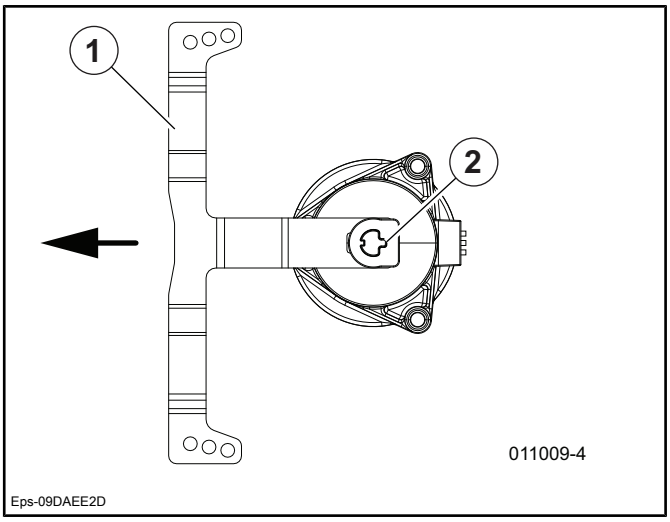
Steering Position Sensor Installation

1. Install the grommet on the shaft of the new steering position sensor.



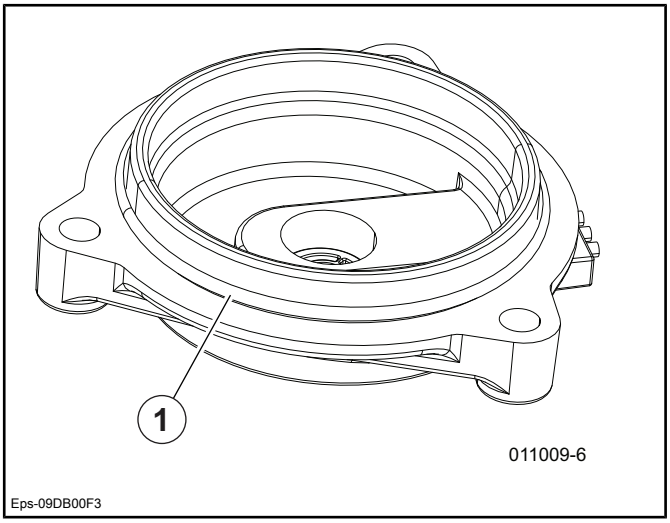
1. Grommet

2. Temporarily install the steering position sensor bracket onto the shaft of the steering position sensor. Align the shaft and bracket to face FORWARD as shown.



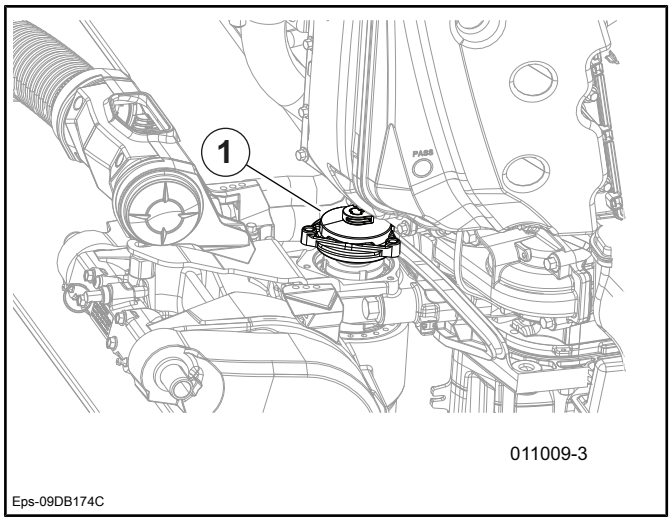
1. Steering position sensor bracket
2. Shaft

3. Remove the bracket from the sensor.
4. Apply a light coat of Triple Guard grease to a new o-ring. Install the o-ring on the steering position sensor.



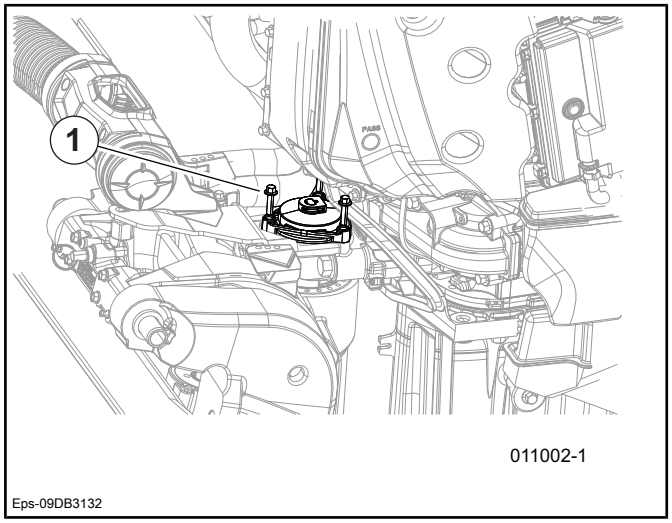
1. O-ring

5. Install the steering position sensor and o-ring into the upper steering bracket.



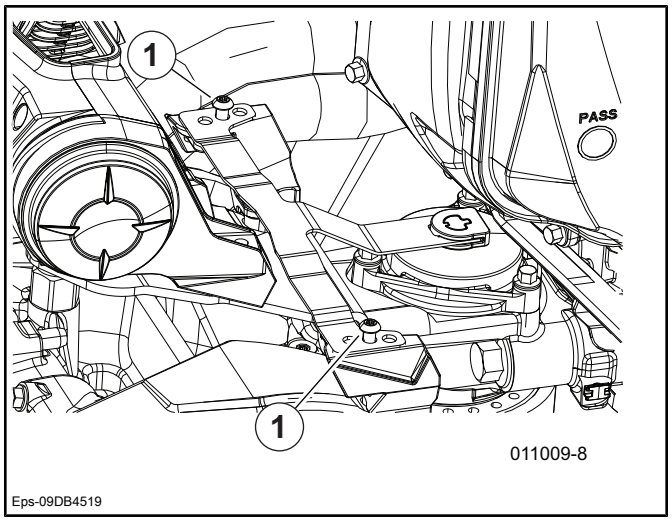
1. Steering position sensor

6. Install the three screws in the steering position sensor. Tighten the screws to a torque of 79 to 96 in. lbs. (9 to 10 N·m). To ease access to the screws, turn the outboard to PORT or STARBOARD as needed.



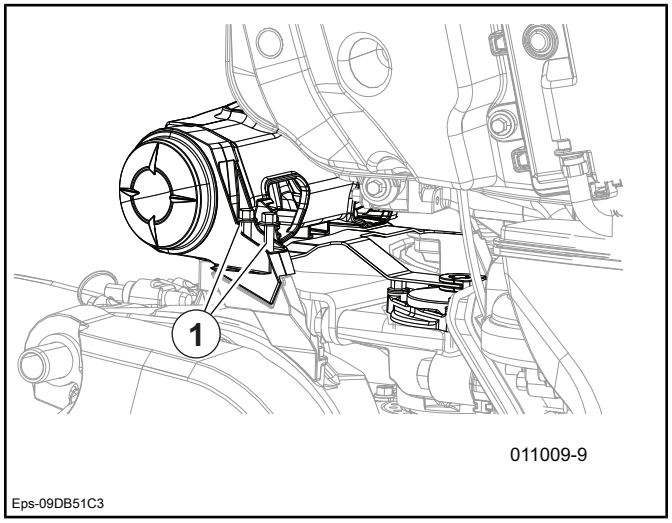
1. Three screws

7. Install the steering position sensor bracket into the grommet on the steering position sensor. Align the screw holes in the bracket with the holes in the rigging housing mounting bracket.
8. Install the two retaining screws into the steering position sensor bracket. Tighten the screws to a torque of 60 to 84 in. lbs. (6.7 to 9.5 N·m). To ease access to the screws, turn the outboard to PORT or STARBOARD as needed.



1. Two screws

9. Route the steering position sensor cable to the DPS module and connect the electrical connector at the DPS module.
10. Move the rigging housing rearward into position. Align the screw holes in the rigging housing with the holes in the rigging housing mounting bracket.
11. Install the four retaining screws into the rigging housing and swivel bracket. Be SURE the steering position sensor bracket stays aligned in the sensor grommet. Tighten the screws to a torque of 79 to 96 in. lbs. (9 to 10 N·m).



1. Four screws (Port side shown)

12. Install the starboard and port frame, then the top cover. Refer to **Engine Cover and Frame Service**.

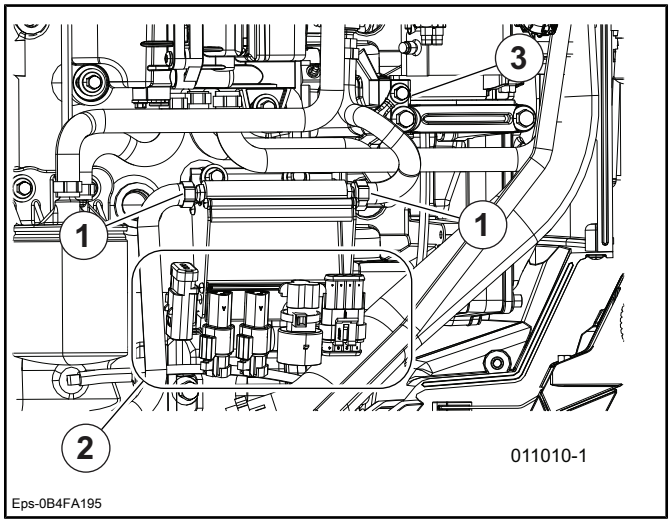
IMPORTANT: Calibrate the appropriate system after installing the steering position sensor. Refer to **Steering Position Sensor Calibration**.

DPS Module Service

DPS Module Removal

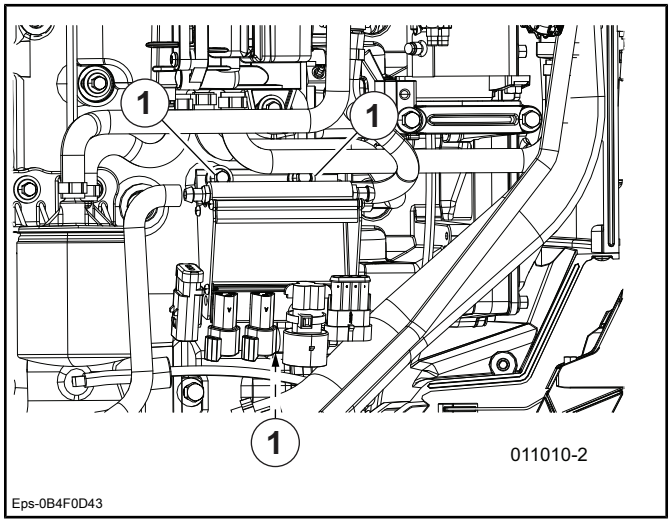
Remove the top cover and starboard frame. Refer to **Engine Cover and Frame Service**.

1. Disconnect the electrical connectors from the DPS module.
2. Remove the *Oetiker* clamps from the cooling hoses.
3. Remove the cooling hoses from the DPS module.
4. Remove the ground wire from the ground screw on the starter lower mounting bracket.



1. Oetiker clamps
2. Electrical connectors
3. ground wire

5. Remove the three DPS module mounting screws and washers.

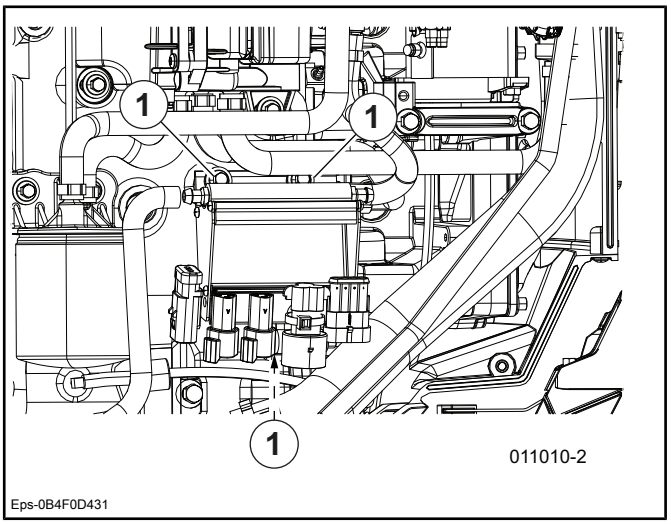


1. Three screws and washers

6. Remove the DPS module from the engine.

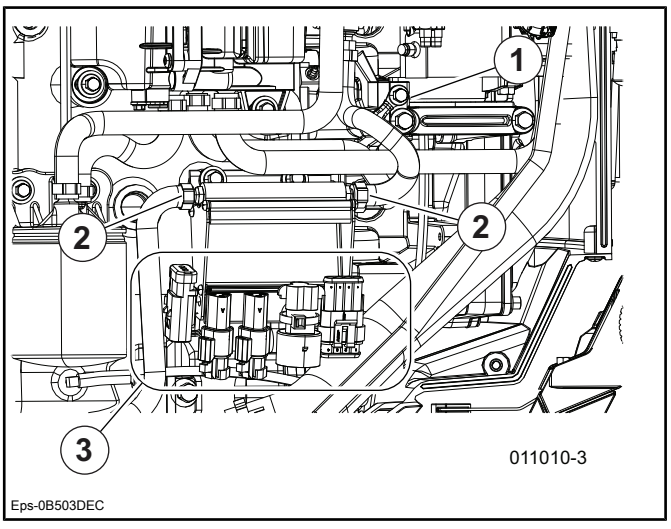
DPS Module Installation

1. Install the DPS module onto the engine.
2. Install the three DPS module washers and mounting screws.



1. Three screws and washers

3. Tighten the screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).
4. Install the ground wire onto the ground screw on the starter lower mounting bracket.
5. Tighten the screw to a torque of 84 to 106 in.lb. (9.5 to 12 N·m).
6. Install the cooling hoses onto the DPS module.
7. Secure the hoses with new 15.7 mm *Oetiker* clamps.
8. Connect the electrical connectors to the DPS module.



1. Ground wire
2. Oetiker clamps
3. Electrical connectors

IMPORTANT: Use *Evinrude Diagnostic* software v6.4 or higher to install correct software into the DPS module. Refer to **DPS Software Installation.** After installing software, use *Evinrude Diagnostic* software to calibrate the DPS system. Refer to **DPS System Calibration**.

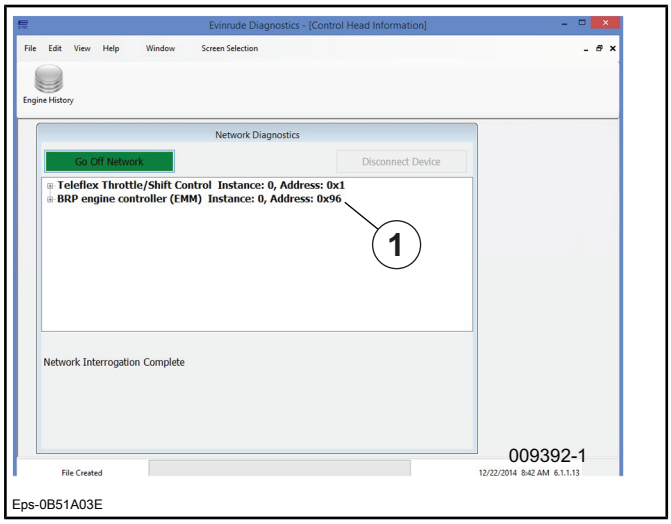
Install the starboard frame and top cover. Refer to **Engine Cover and Frame Service**.

DPS Software Installation

1. Upload the correct software to replacement DPS modules after installing the DPS module on the engine. Refer to the table below.

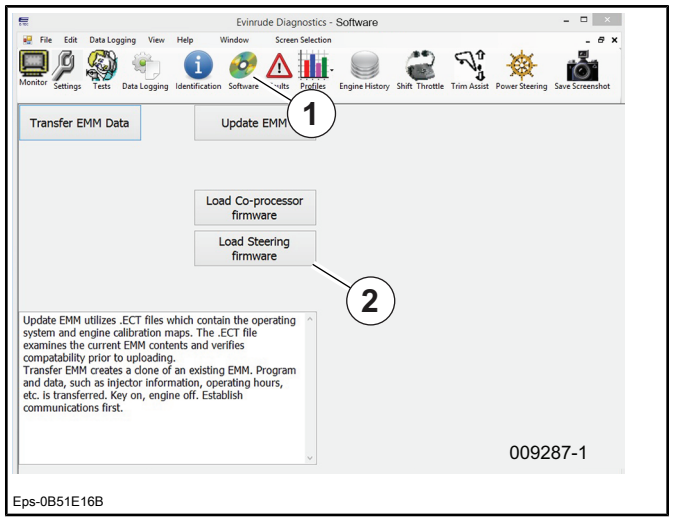
Version	Revision
3030559	2024546 or higher

2. Use *Evinrude Diagnostics* software v 6.4 or higher to upload DPS software.
3. Connect the MPI adapter and adapter cable to the laptop and to the *NMEA 2000* network.
4. Turn the key switch to the ON position, then start the diagnostic program.
5. After the program connects to the network, select the *Engine Controller (EMM)* from the device list .



1. *Engine controller*

6. When the diagnostic program connects to the outboard, select the *Software* button, then select the *Load Steering Firmware* button.



1. *Software button*
2. *Load Steering Firmware button*

7. A pop-up window will appear. Select the correct software from the list. Then follow the on-screen prompts to install the software into the DPS module.
8. After the software is installed, turn the key switch OFF and then ON to complete the process.

IMPORTANT: Use *Evinrude Diagnostic* software to calibrate the DPS system after installing the software. Refer to **DPS System Calibration**.

DPS System Calibration

⚠ WARNING

The DPS system REQUIRES calibration when:

- **installing multiple outboards (initial installation)**
- **replacing a DPS module**
- **replacing a steering pressure sensor**
- **replacing a steering position sensor**

Failure to complete DPS system calibration can result in damage to the tie bar(s) and/or the transom of the boat due to overloading. Refer to *DPS System Calibration*.

Use *Evinrude Diagnostics* software, v 6.4 or higher to calibrate the DPS system.

Connect the MPI-adapter and adapter cable to the laptop and the *NMEA 2000* network. Turn the key switch to the ON position and start the diagnostic program.

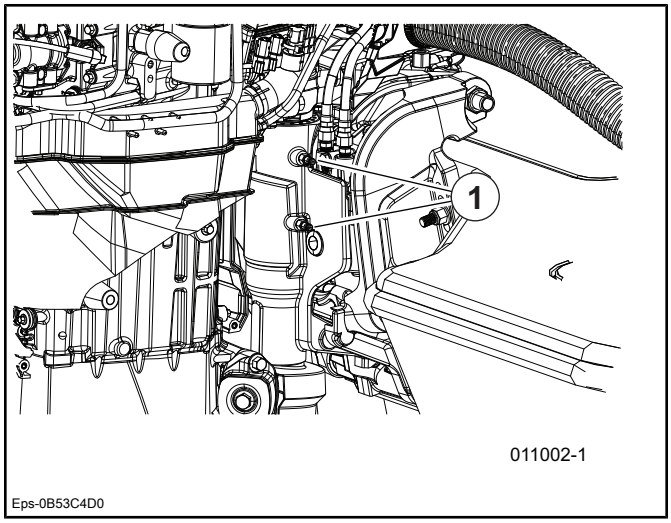
Follow the instructions in the next sections to complete the calibration processes.

Steering Pressure Sensor Calibration

IMPORTANT: Calibrate the pressure sensor when:

– replacing a DPS module
– replacing a DPS manifold
– replacing a steering pressure sensor

1. Connect a piece of tubing to each bleed valve.
2. Insert the open end of the tubing into a container appropriate for collecting hydraulic steering fluid.

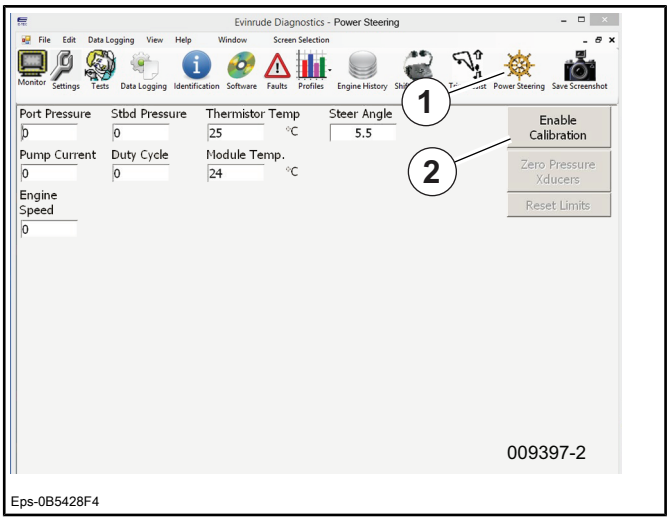


1. Bleed valves

3. Open the both bleed valves at least one-half turn to relieve pressure on the hydraulic steering system.
4. Wipe up any spilled steering fluid with shop towels.

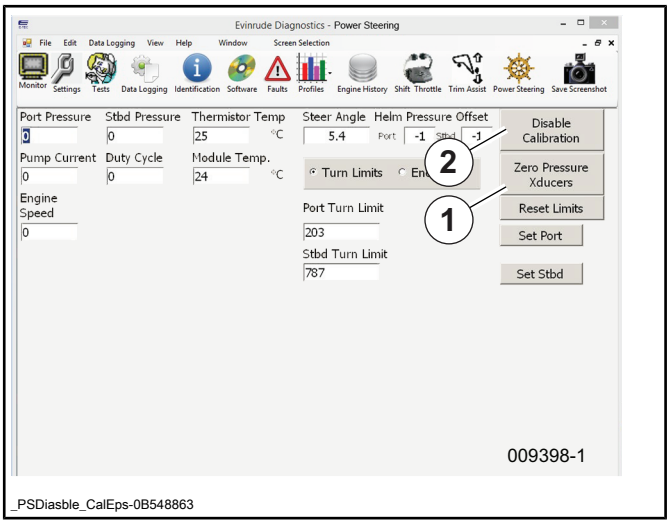
ENVIRONMENTAL NOTE
Dispose of contaminated shop towels according to local environmental regulations.

5. Use *Evinrude Diagnostics* software v 6.4 or higher to calibrate steering pressure sensors.
6. After the program connects to the network, select *Engine Controller (EMM)* from the device list.
7. Then select the *Power Steering* button.
8. Select *Enable Calibration*. The power steering pump is disabled while in calibration mode.



1. Power Steering
2. Enable Calibration

9. Select *Zero Pressure Sensors*. The button will deactivate while setting the ZERO point. Wait for the button to activate BEFORE continuing.
10. Select *Disable Calibration* to save the setting and re-enable the power steering pump.



1. Zero Pressure Sensors
2. Disable Calibration

11. Close both bleed valves. Tighten to a torque of 84 to 120 In. lbs. (9.5 to 13.5 N·m). Do NOT over-tighten.
12. Bleed the steering system. Refer to **Filling and Bleeding the Hydraulic Steering System**.

Steering Position Sensor Calibration

IMPORTANT: Calibrate the steering position sensor when:

– replacing a DPS module
– replacing a steering position sensor

Use *Evinrude Diagnostics* software v 6.4 or higher to calibrate the steering position sensor.

Dual Outboard Installations

NOTICE

Failure to complete steering sensor calibration on dual engine applications can result in damage to the tie bar(s) and/or the transom of the boat due to overloading.

- **The power steering pump must NOT run during the calibration procedure.**
- **The diagnostics software will disable the pump for outboard being calibrated.**

IMPORTANT: Calibrate the steering position sensors on dual outboard installations when:

- installing outboards for the first time
- replacing a DPS module
- replacing a steering position sensor

Dual outboard installations REQUIRE calibration of the DPS equipped outboard. Calibrate the **End Point** of the DPS outboard FIRST. Then calibrate the **Turn Limit** .

Calibrate End Points

NOTICE

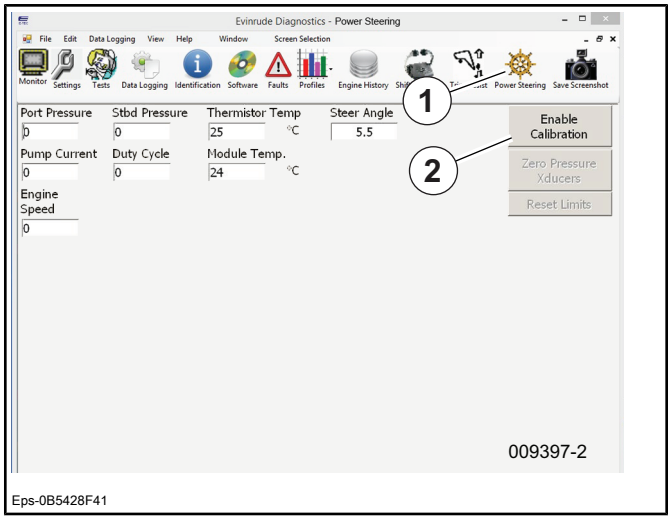
Calibrating end points requires disconnecting the tie bar. During this procedure outboards could contact, resulting in damage to the engine covers. Have an assistant manually move outboards to prevent damage.

Before calibrating End Points:

- disconnect the tie bar from the outboards

After the program connects to the network, select the *Engine Controller (EMM)* from the device list for the DPS outboard. Then select the *Power Steering* button.

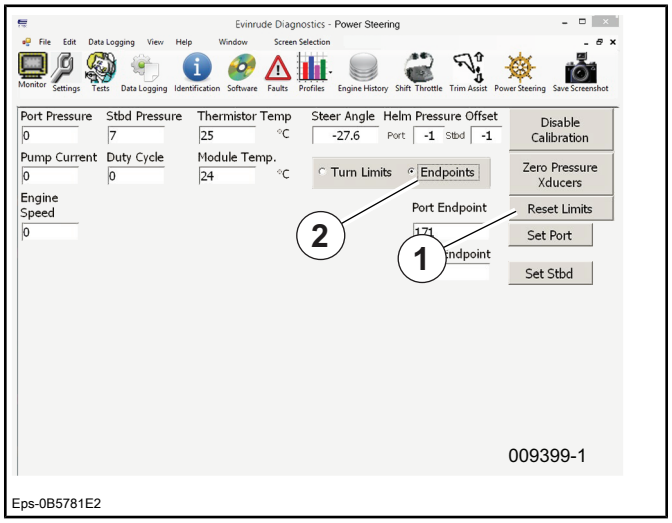
1. Select *Enable Calibration*. The power steering pump is disabled while in calibration mode.



Eps-0B5428F41

1. *Power Steering*
2. *Enable Calibration*

2. Press *Reset Limits*. Then be SURE to select ***End Points***.



Eps-0B5781E2

1. *Reset Limits*
2. *End Points*

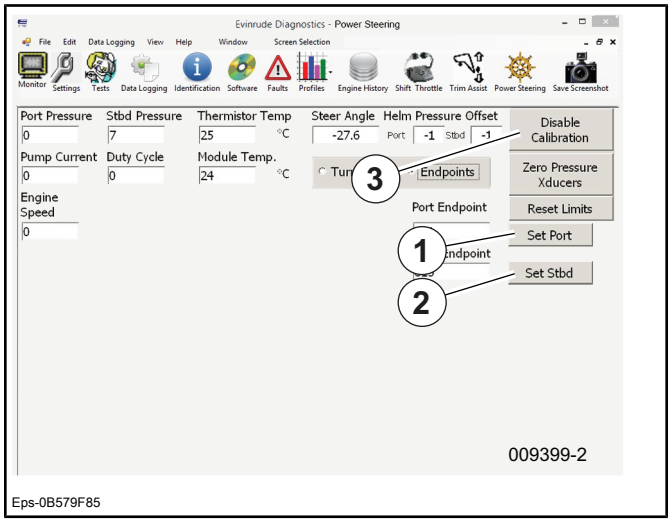
3. Slowly turn the steering wheel until the outboard is turned fully to PORT.

IMPORTANT: Make sure outboards do not contact. Slowly turn the steering wheel, while an assistant manually moves the disconnected outboards.

4. Then press the *Set Port* button. The button will deactivate while saving the PORT end point. Wait for the button to activate BEFORE continuing.
5. Slowly turn the steering wheel until the outboard is turned fully to STARBOARD.

IMPORTANT: Make sure outboards do not contact. Slowly turn the steering wheel, while an assistant manually moves the disconnected outboards.

6. Then press the *Set Starboard* button. The button will deactivate while saving the STARBOARD end point. Wait for the button to activate BEFORE continuing.
7. Select *Disable Calibration* to save the setting and re-enable the power steering pump.



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1. *Set Port*
2. *Set Starboard*
3. *Disable Calibration*

Before continuing:

- turn the key switch to the OFF position
- Turn the key switch to the ON position

8. After completing end points calibration, calibrate the turn limits. See **Calibrate Turn Limits**.

Calibrate Turn Limits

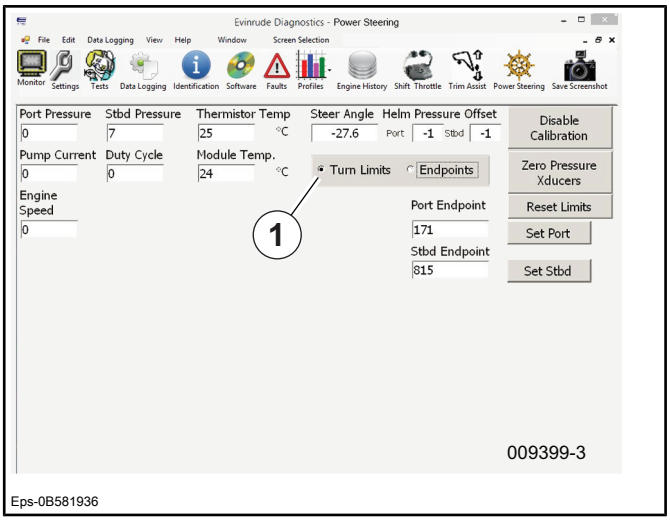
Before calibrating Turn Limits:

- connect tie bar to the outboards
- adjust outboard alignment

Turn the key switch to the ON position, then start the diagnostic program.

After the program connects to the network, select from the device list for the *Engine Controller (EMM)* the DPS outboard. Then select the *Power Steering* button.

1. Select *Enable Calibration*. The power steering pump is disabled while in calibration mode.
2. Then be SURE to select ***Turn Limits***.



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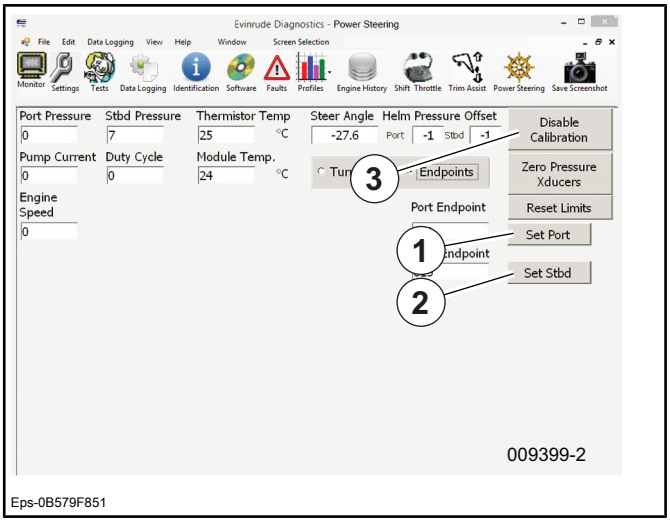
1. *Turn limits*

3. Turn the steering wheel until the outboards are turned fully to PORT. Then press the *Set Port* button. The button will deactivate while setting the PORT turn limit. Wait for the button to activate BEFORE continuing.
4. Turn the steering wheel until the outboards are turned fully to STARBOARD. Then press the *Set Starboard* button. The button will deactivate while setting the STARBOARD turn limit. Wait for the button to activate BEFORE continuing.
5. Select *Disable Calibration* to save the settings and re-enable the power steering pump.



Eps-0B579F851

1. *Set Port*
2. *Set Starboard*
3. *Disable Calibration*

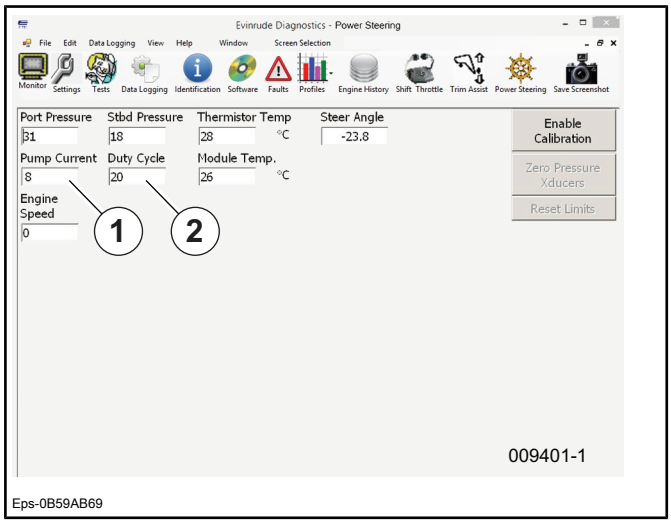
Before continuing:

- turn the key switch to the OFF position.
- Turn the key switch to the ON position

6. Test the steering system. See **Steering System Test**.

Steering System Test

1. Turn the steering wheel fully to PORT. The power steering pump should run, then shut OFF when the engine is turned fully to PORT.
2. Turn the steering wheel fully to STARBOARD. The power steering pump should run, then shut OFF when the engine is turned fully to STARBOARD.
3. In some installations it may be difficult to hear the power steering pump run. Use the *Power Steering* screen of *Evinrude Diagnostics* software to monitor the pump *Current* and *Duty Cycle*.



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1. *Pump Current*
2. *Duty Cycle*

These values should be zero when the pump is NOT running.

DPS Manifold Service

NOTICE

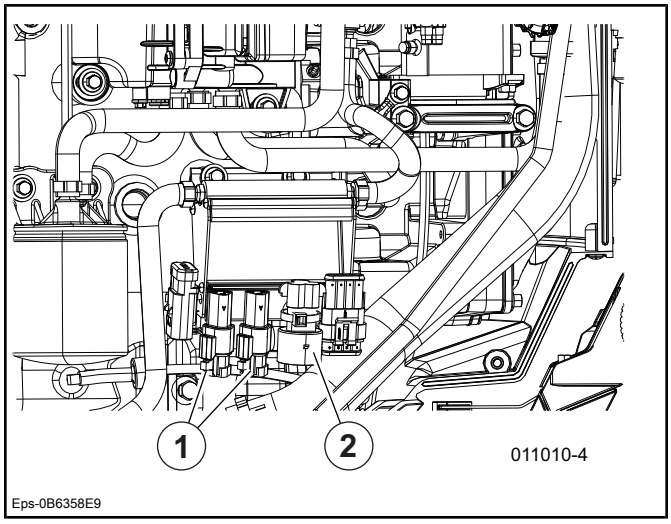
Service procedures of hydraulic manifolds MUST occur in a clean, dust-free environment.
When cleaning components use lint-free shop towels.
Dirt, dust or other contaminants in the hydraulic system can result in malfunctions or failures.

Remove the top cover and starboard frame. Refer to **Engine Cover and Frame Service**.

Turn the outboard fully to PORT. Tilt the outboard to the fully UP position. Support the outboard to prevent it from falling unexpectedly during service.

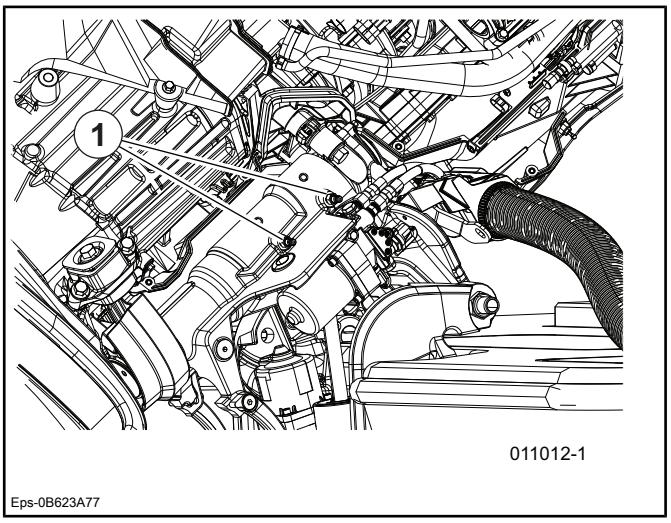
Removal

1. Disconnect the two steering pressure sensor electrical connectors and steering motor electrical connector from the DPS control module.



1. Two steering pressure sensor electrical connectors
2. Steering motor electrical connector

2. Make note of the routing for the pressure sensor and steering motor cables for re-assembly. Carefully remove the cables back to the DPS manifold.
3. Connect a piece of tubing to each bleed valve.
4. Insert the open end of the tubing into a container appropriate for collecting hydraulic steering fluid.



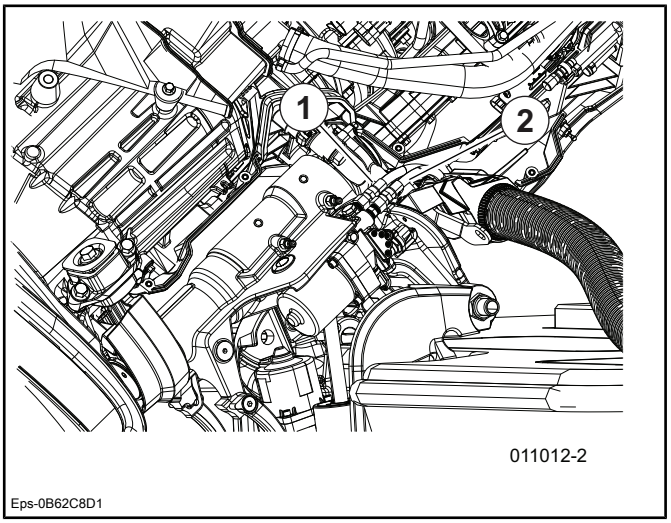
1. Bleed valves

5. Open the bleed valve one-half turn to relieve steering system pressure. Wipe off any spilled hydraulic fluid.

ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

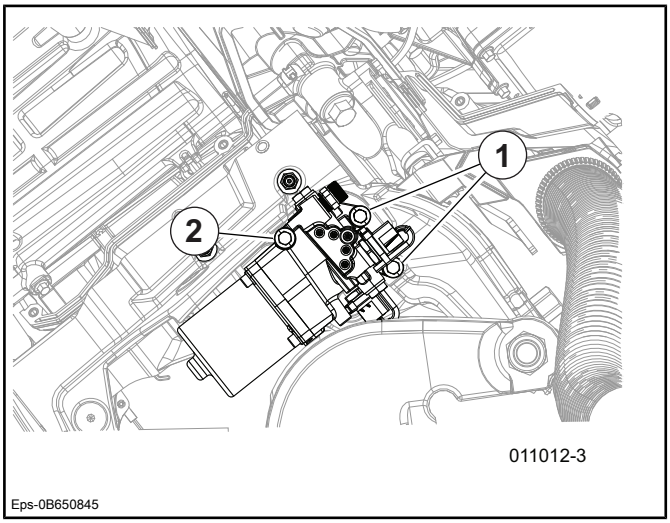
6. Label the hydraulic steering hoses PORT and STARBOARD for correct installation later.



1. PORT hydraulic steering hose
2. STARBOARD hydraulic steering hose

NOTE: A quantity of hydraulic oil will spill as the manifold assembly is removed from the swivel bracket.

7. Place oil absorbent mats or shop towels in a large pan. Place the pan under the outboard to catch hydraulic fluid while disconnecting the steering hoses and removing the manifold.
8. Remove the hydraulic steering hoses from the manifold.
9. Plug the fittings of the hydraulic hoses to prevent contaminants from entering the hoses.
10. Remove the two short screws and one long screw retaining the manifold to the swivel bracket. Then remove the manifold from the outboard.



1. Two short screws
2. Long screw

Cleaning and Inspection

NOTICE

Apply cleaning solvent to lint-free shop towels to clean hydraulic oil residue from all surfaces.
Do NOT spray cleaning solvent on the swivel bracket. Solvent can seep into oil passages resulting in contamination of hydraulic fluids.

Use lint-free shop towels to wipe up spilled hydraulic fluid.

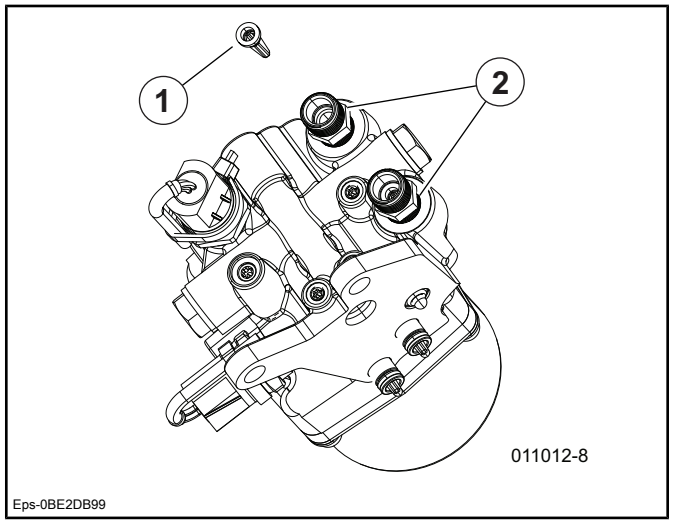
ENVIRONMENTAL NOTE

Dispose of spilled hydraulic fluid or contaminated shop towels in an environmentally responsible manner, or according to local regulations.

Filters

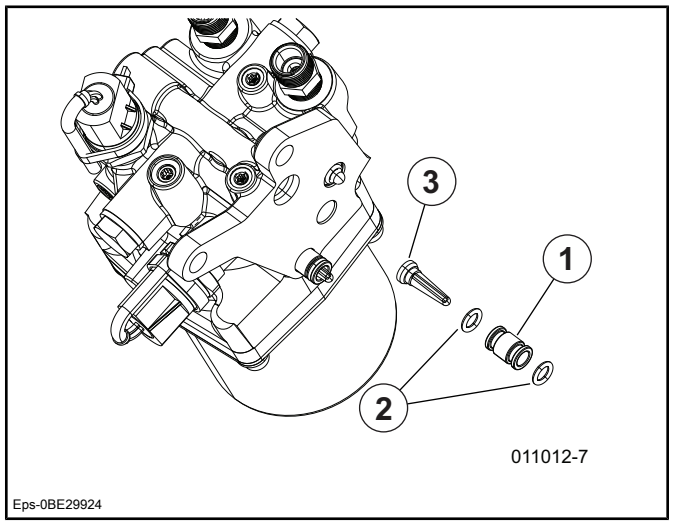
The DPS manifold uses four filters.

Two filters are installed in the hydraulic steering hose fittings. Use an appropriate tool, such as a small pick, to remove the filters from the fittings. Discard the filters, do NOT re-use. Install new filters into the fittings BEFORE installing the manifold on the outboard.



1. Filter
2. Fitting

Two filters are installed in the fluid passage couplers. Take CARE not to damage the couplers when removing. Use an appropriate tool to remove the couplers, o-rings and filters from the manifold. Discard the filters and o-rings, do NOT re-use. Install new filters into the couplers and install new o-rings on the couplers BEFORE installing the manifold on the outboard.



1. Coupler
2. O-rings
3. Filter

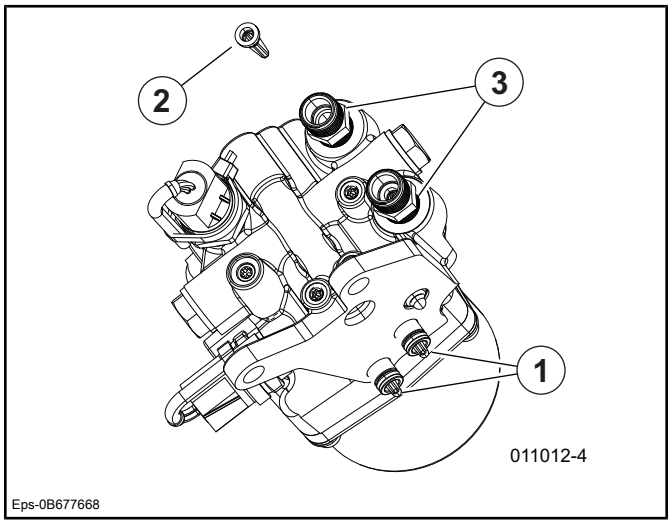
Installation

NOTICE

Make sure ALL mating surfaces of the DPS/TNT manifolds and stern and swivel bracket are COMPLETELY CLEAN AND FREE OF ALL DEBRIS.
Dirt, dust or other contaminants in the hydraulic system can result in malfunctions or failures.

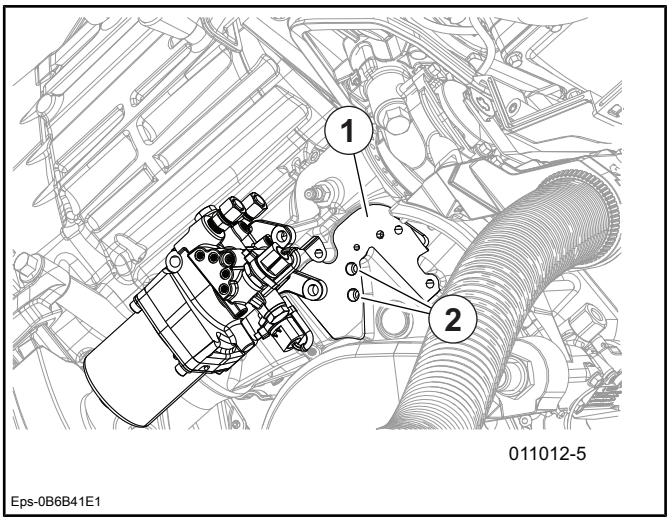
Service replacement manifold assemblies may have filters installed, or included in the packaging.

1. Ensure two filters are installed into the hydraulic steering hose fittings, and two filters and O-rings are installed on the couplers BEFORE installing the DPS manifold on the swivel bracket.

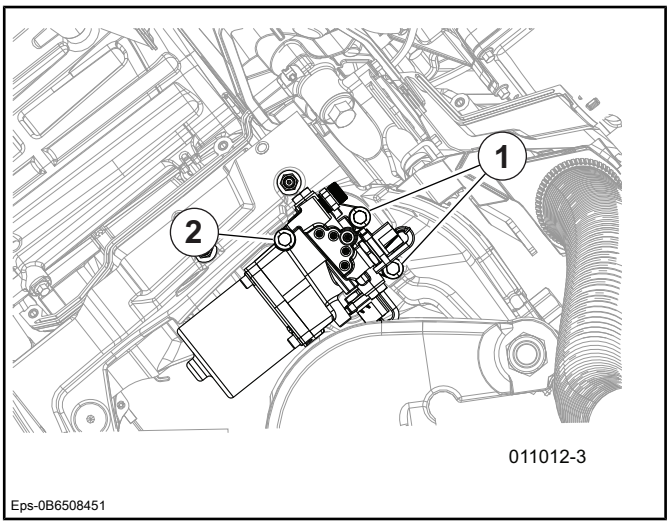


1. Filters and couplers
2. Hydraulic steering hose fittings
3. Filter

2. Align the DPS manifold with the mounting surface. Push the manifold into place, ensuring the couplers engage the fluid passages,

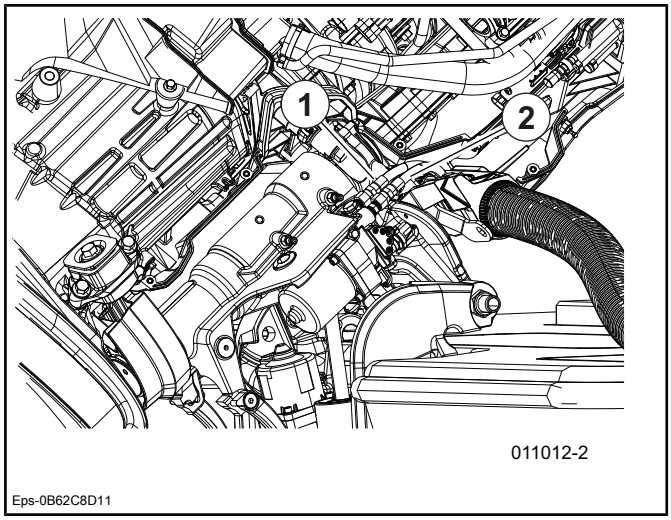


3. Install the two short screws and one long screw. Tighten screws to a torque of 180 to 204 In. lbs. (20.3 to 23 N·m).



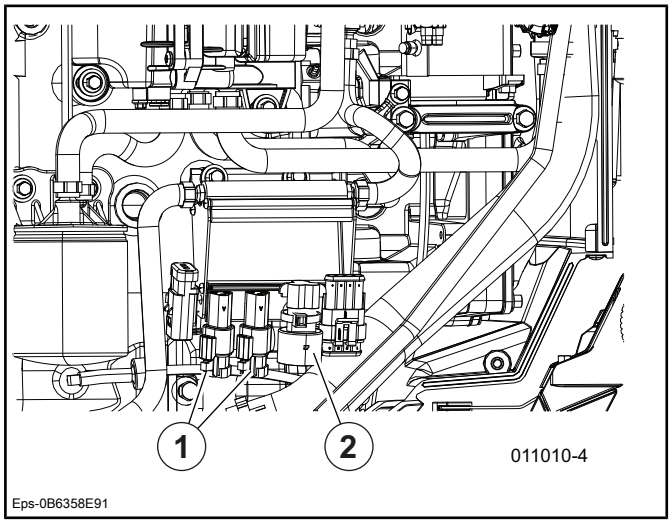
1. Two short screws
2. Long screw

4. Remove the plugs from the DPS manifold steering hose fittings and from the steering hoses.
5. Install the PORT hydraulic steering hoses first. Tighten the fitting to a torque of 15 ft. lbs (20.3 N·m).
6. Install the STARBOARD hydraulic steering hose last. Tighten the fitting to a torque of 15 ft. lbs (20.3 N·m).



1. PORT hydraulic steering hose
2. STARBOARD hydraulic steering hose

7. Route the pressure sensor and steering motor cables back to the DPS control module. Refer to the routing notes made at the time of removal.
8. Connect the two steering pressure sensor electrical connectors and steering motor electrical connector to the DPS control module.



1. Two steering pressure sensor electrical connectors
2. Steering motor electrical connector

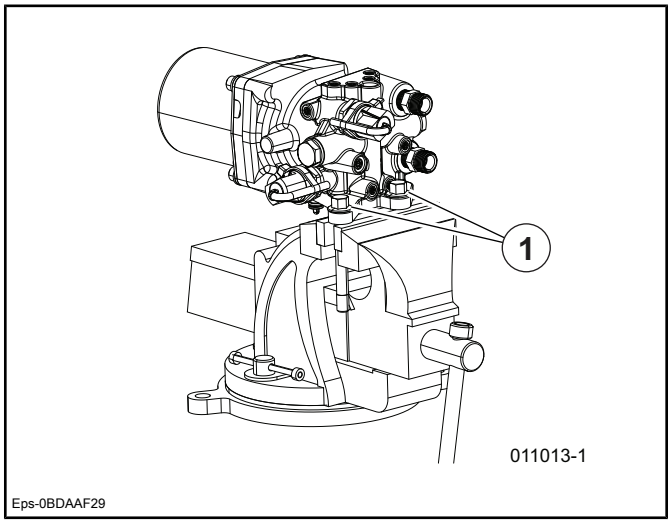
9. Fill and bleed the steering system. Refer to **Filling and Bleeding the Hydraulic Steering System**.
10. Calibrate the steering pressure sensors. Refer to **Steering Pressure Sensor Calibration**.
11. Calibrate the steering position sensor. Refer to **Steering Position Sensor Calibration**.

Install the starboard frame and top cover. Refer to **Engine cover and Frame Service**.

Steering Pressure Sensors

Service of the DPS manifold requires removal from the outboard. Refer to **Removal** in **DPS Manifold Service**.

1. Use two scrap screws to secure the DPS Manifold to a bench vise.



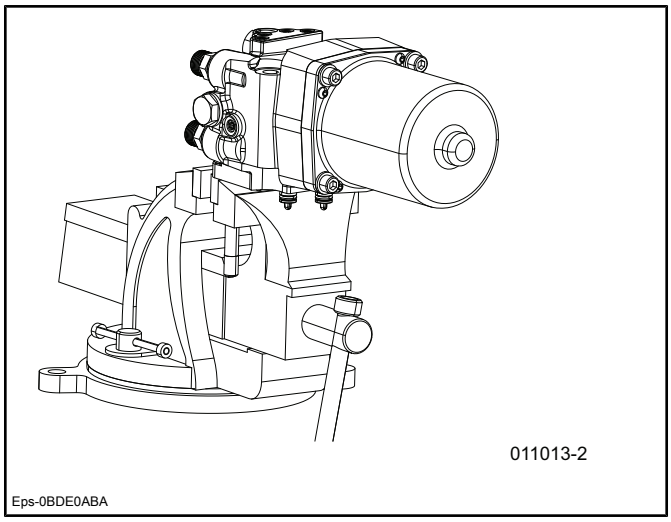
1. Scrap screws

IMPORTANT: Sensors are NOT interchangeable.

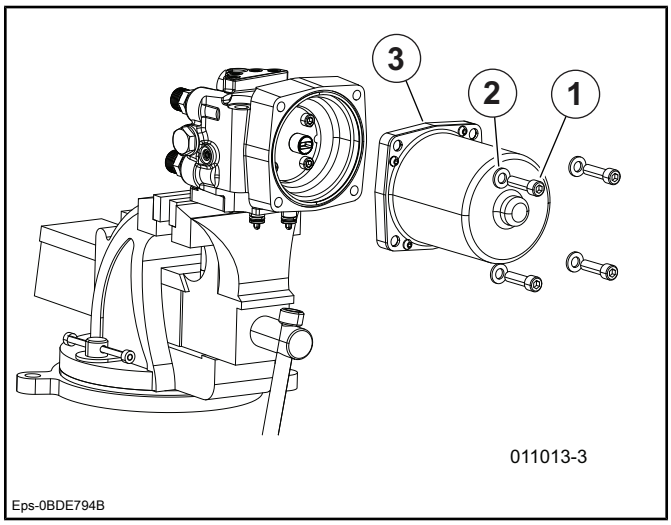
2. Make note of tie strap locations for installation. Use an appropriate wrench to remove the sensor(s).
3. Install the sensor(s) and tighten to a torque of 144 to 168 In. lbs. (17 to 19 N·m).
4. Install tie strap, P/N 320107 to secure sensor lead to sensor as previously noted.
5. Be sure to calibrate the steering pressure sensors after the DPS manifold is re-installed on the outboard. Refer to **Steering Pressure Sensor Calibration**.

Electric Motor

1. Use two scrap screws to secure the DPS Manifold to a bench vise.

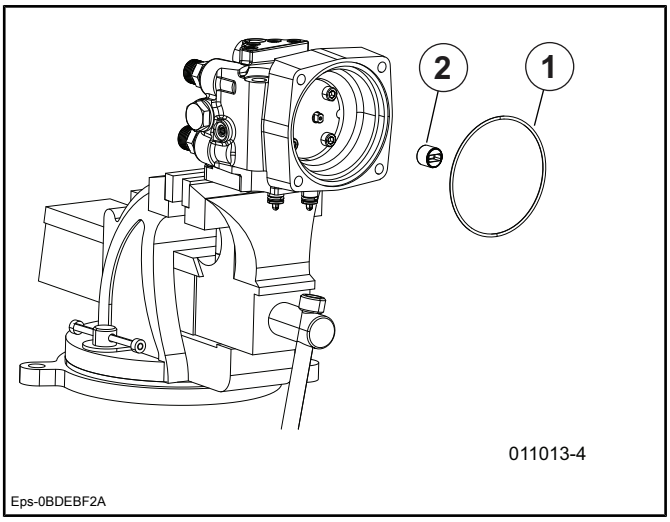


2. Remove the four screws and washers retaining the electric motor. Then remove the motor from the manifold housing.



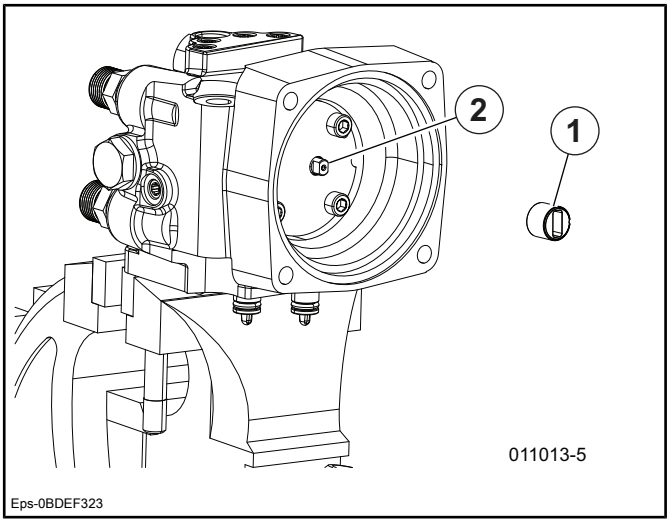
1. Screws
2. Washers
3. Electric motor

3. Remove the O-ring and coupler from the manifold housing, or electric motor.



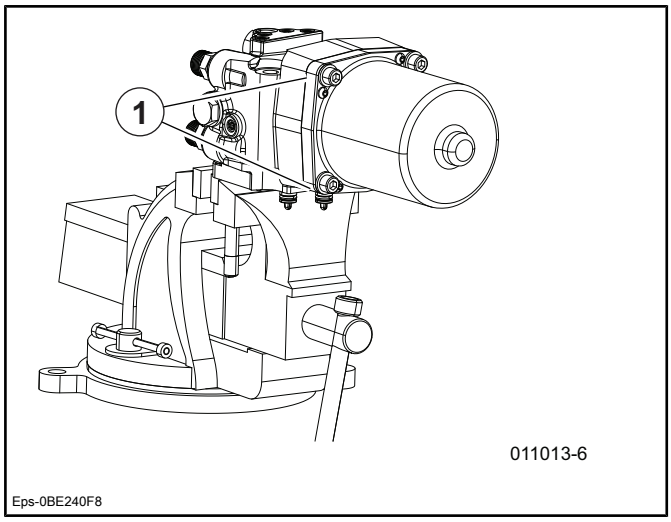
1. O-ring
2. Coupler

4. Clean and dry all parts thoroughly.
5. Align the slot in the coupler with the shaft on the pump (shown) and with the shaft on the electric motor.



1. Couplet
2. Shaft

6. Install the electric motor on the manifold assembly. Install four screws and washers.
7. Tighten screws to a torque of 60 to 84 In. lbs.(7 to 10 N·m).



1. Screws

Trim and Tilt System Service

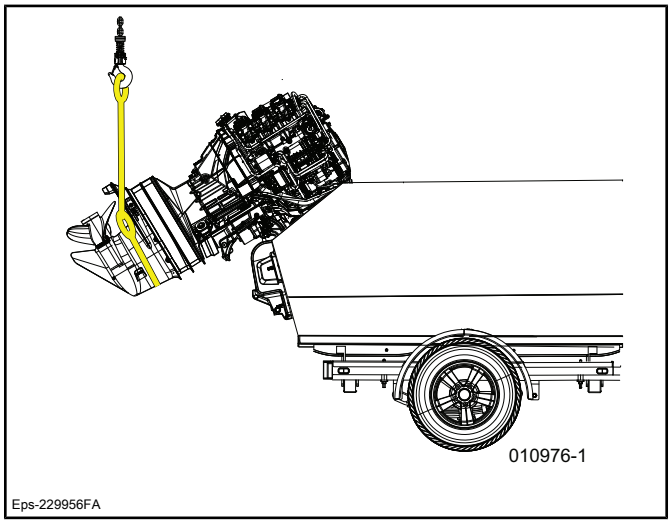
Trim and Tilt Hydraulic Unit Service

1. Remove the top and rear engine covers and starboard and port frames. Refer to **Engine Cover and Frame Service**.
2. Make note of the routing of electrical wiring to the trim and tilt hydraulic assembly prior to removal.

⚠ WARNING

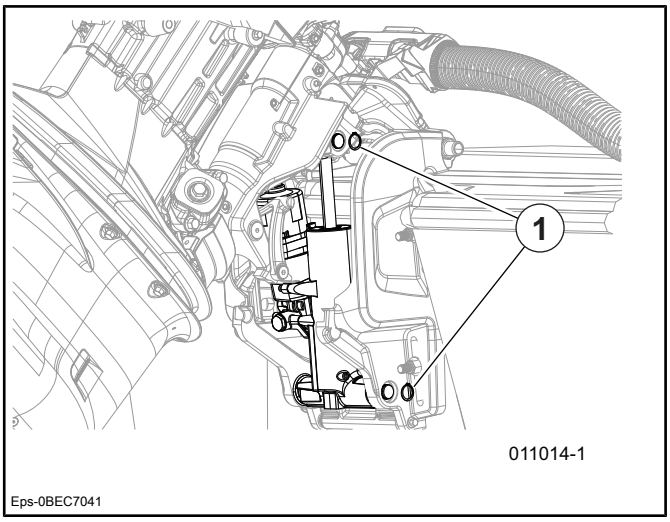
Support the outboard by the gearcase in the UP position, with a suitable hoist.
When servicing the trim and tilt assembly, the outboard will drop from the tilted position.
Avoid personal injury; always support the outboard's weight with a suitable hoist during service.

3. Tilt the outboard to the full UP position. Open the manual release valve if the trim and tilt hydraulic unit is non-functional.
4. Disconnect the battery cables at the battery.
5. Disconnect the trim and tilt electrical connections.
6. Remove the electrical wiring back to the hydraulic unit.
7. Use a strap and an appropriate hoist to support the outboard by the gearcase. The outboard will drop when the trim and tilt assembly is removed.



Removal

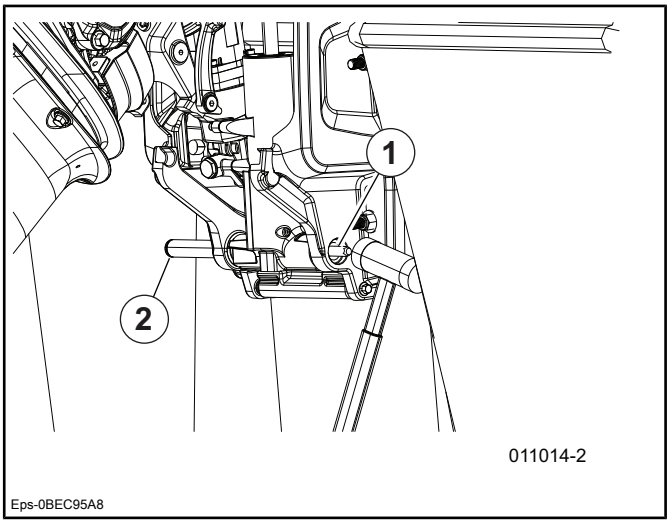
1. Remove the retaining rings from the upper and lower tilt pins. Remove either the starboard side (shown), or port side of the outboard



1. Retaining rings

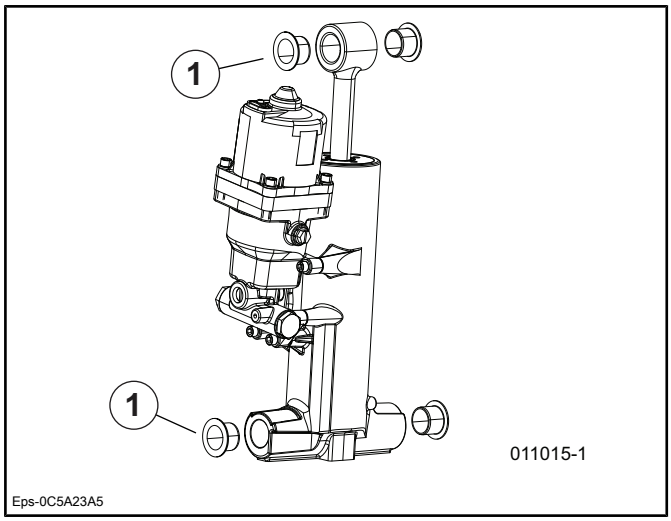
2. Use a brass drift pin and a mallet to drive out the lower pin. Then use the drift pin to drive out the upper pin.

   Use of the drift pin will prevent the hydraulic unit from falling and causing injury or damage.



1. Brass drift pin
2. Lower tilt pin

3. Remove the drift pin and lower the trim and tilt assembly from the outboard.
4. Remove the upper and lower tilt pin bushings from the trim and tilt hydraulic unit.

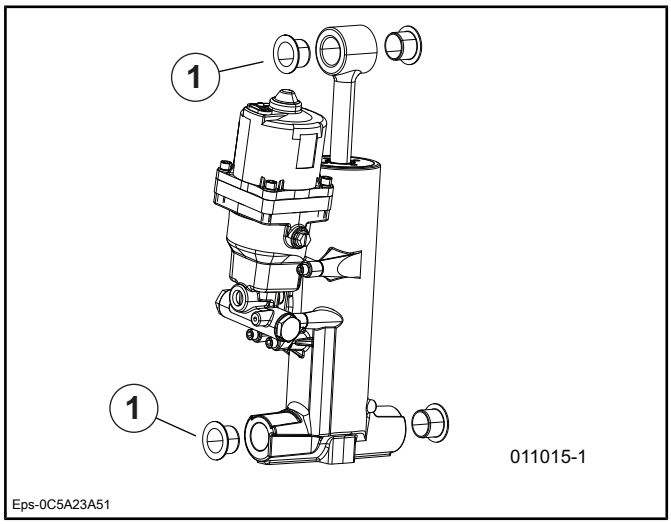


1. Bushings

5. Clean the bushings and inspect for damage or wear. Replace damaged or worn bushings.

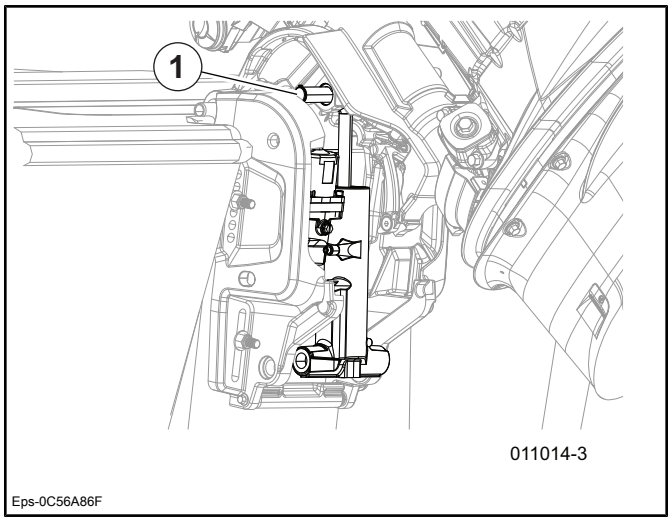
Installation

1. Apply *Triple Guard* grease to the upper and lower tilt pin bushings.
2. Install the bushings into the trim and tilt hydraulic unit.



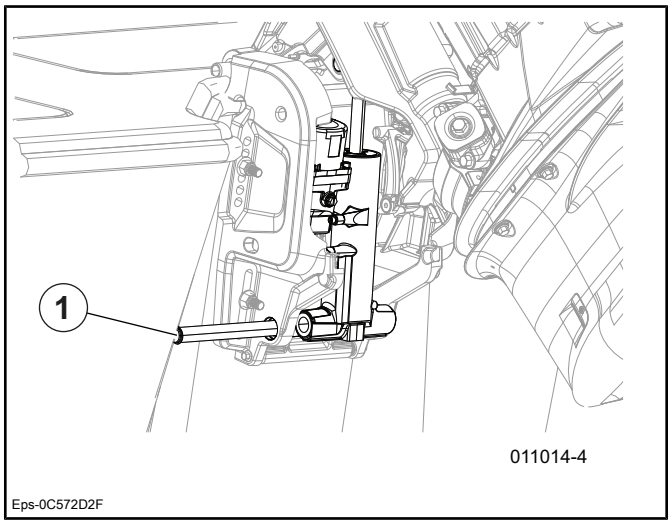
1. Bushings

3. Install the upper tilt pin into the boss of the swivel bracket.
4. Align the tilt rod into the boss. Install the tilt pin through the tilt rod and through the opposite side of the boss.



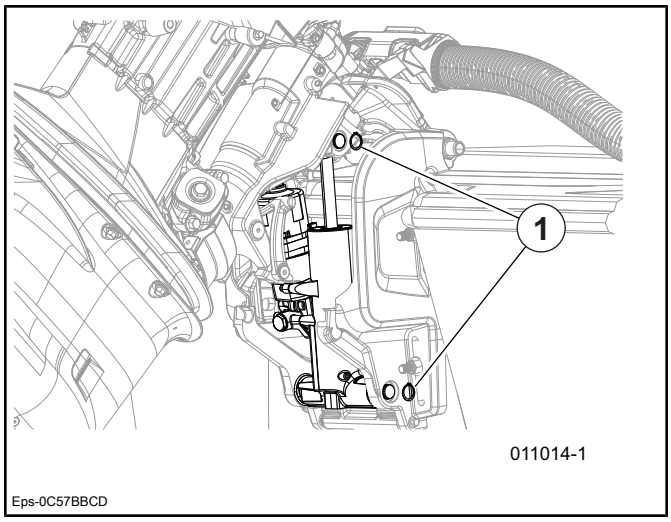
1. Upper tilt pin

5. Install the lower tilt pin into the boss of the stern bracket.
6. Align the lower boss of the trim and tilt unit with the boss of the swivel bracket. Install the tilt pin through the trim and tilt unit and through the opposite swivel bracket.



1. Lower tilt pin

7. Make sure the upper and lower tilt pins are fully installed thru their respective bosses and stern brackets.
8. Install the retaining rings on the upper and lower tilt pins..



1. Retaining rings

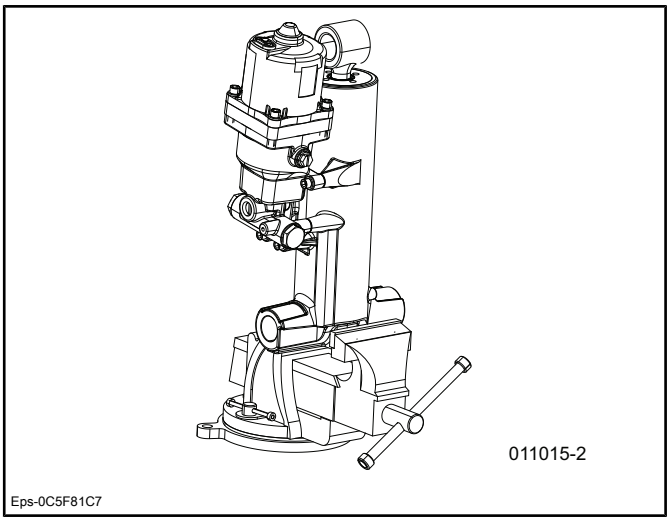
9. Route the electrical wiring from the trim and tilt hydraulic assembly back to the rigging center area. Refer to notes made prior to removal.
10. Connect the trim motor electrical connectors.
11. Remove the strap supporting the outboard and tilt the outboard down.
12. Install the port frame. Refer to **Engine Cover and Frame Service**.
13. Connect the battery cables at the battery.
14. Install the starboard frame, and top and rear engine covers. Refer to **Engine Cover and Frame Service**.

Electric Motor

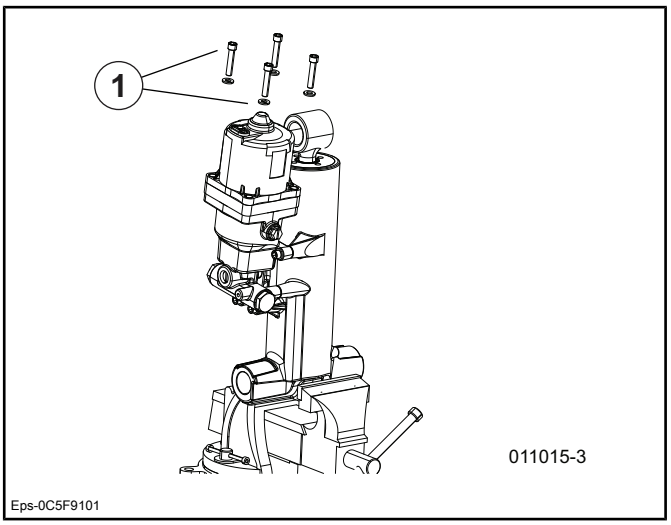
Removal

Electric motor service requires removing the trim and tilt hydraulic unit from the outboard. Refer to **Trim and Tilt Hydraulic Unit Service**.

1. Place the trim and tilt hydraulic unit in a bench vise. Use a set of soft-jaws to prevent damaging the unit.

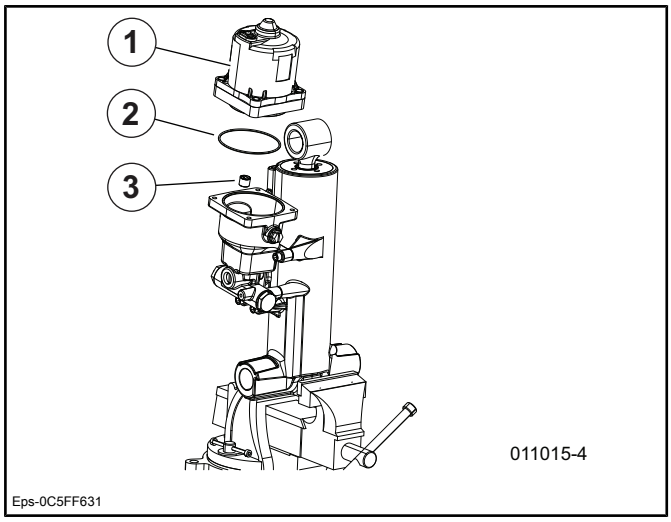


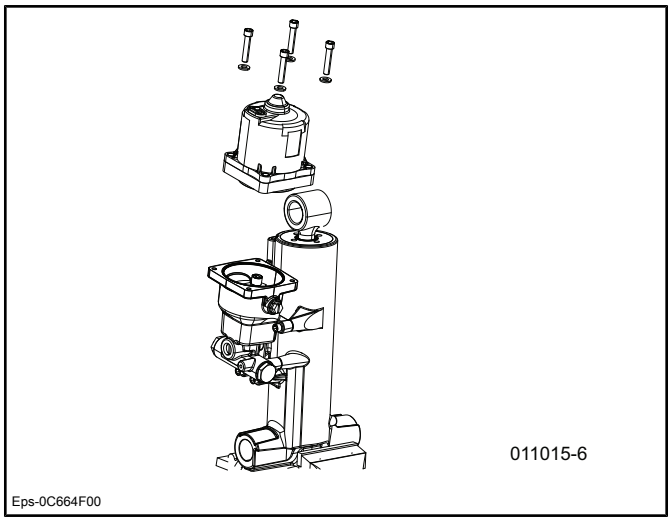
2. Remove the four screws and washers retaining the electric motor to the manifold housing.



1. Four screws and washers

3. Remove the electric motor, O-ring and coupler from the manifold housing.



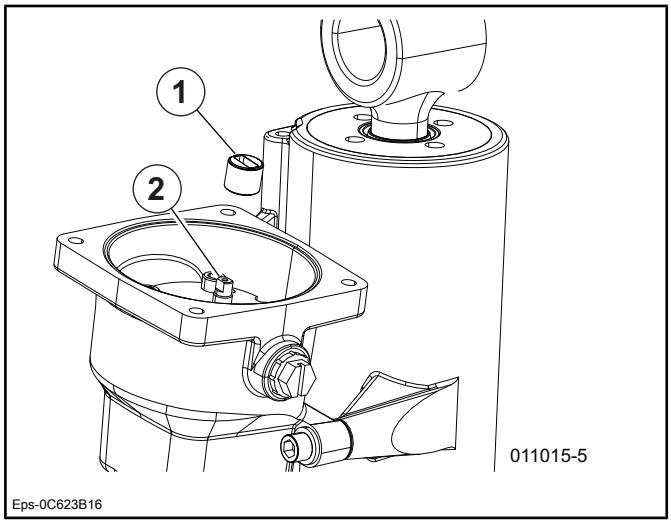


1. *Motor*
2. *O-ring*
3. *Coupler*

4. Clean and dry all parts thoroughly.

Installation

5. Align the slot of the coupler with the slot on the shaft of the pump (shown) and the shaft of the motor.



6. Install a new o-ring on the motor and install the motor onto the trim and tilt unit.
7. Install the four screws with washers and tighten to a torque of 60 to 84 In. lbs.(7 to 10 N·m).

Stern and Swivel Bracket

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING FIXTURE	P/N 357667	288
SPANNER SOCKET	P/N 359224	296, 298, 302–303, 305
SPANNER WRENCH	P/N 362856	306–307
SPANNER WRENCH	P/N 912084	299, 301, 308, 310

SERVICE PRODUCTS

Description	Part Number	Page
HYDRAULIC STEERING FLUID	P/N 770891	306
NO-OX GREASE	P/N 768230	296
TRIPLE GUARD GREASE	P/N 508298	307

Stern and Swivel Bracket Removal

1. Remove the top and rear engine covers and the starboard and port frames. Refer to **Engine Cover and Frame Service**.
2. Tilt the engine partially to gain easy access to the hydraulic steering hoses.
3. Remove the starboard hydraulic steering hose from the stern and swivel assembly.

NOTE: The port steering hose cannot be removed until the starboard steering hose is first removed.

4. Remove the port hydraulic steering hose from the stern and swivel assembly.
5. Install plugs in the starboard and port hydraulic steering hose connections.
6. Use shop towels to clean up any spilled steering fluid. Install cap assemblies in the hose fittings of the stern and swivel assembly.

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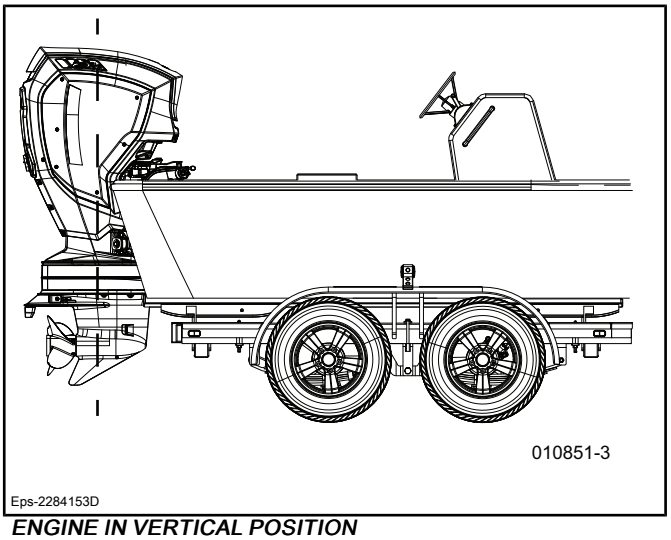
1. Plug and cap assembly

ENVIRONMENTAL NOTE
Dispose of contaminated shop towels according to local environmental regulations.

IMPORTANT: Trim the engine to the vertical position BEFORE beginning the stern and swivel bracket removal procedure.



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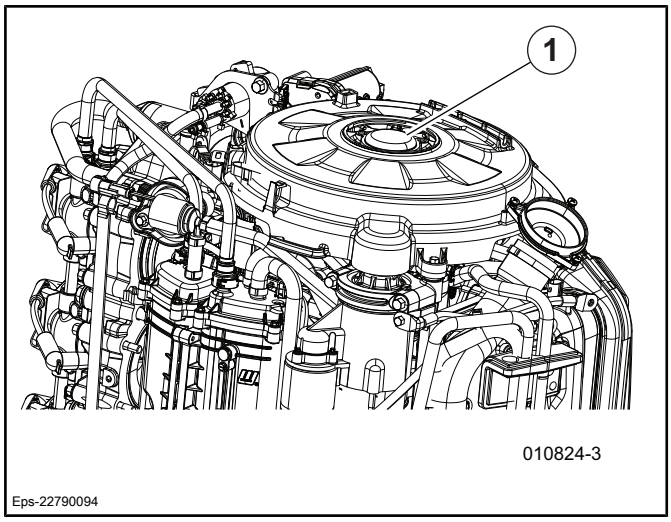
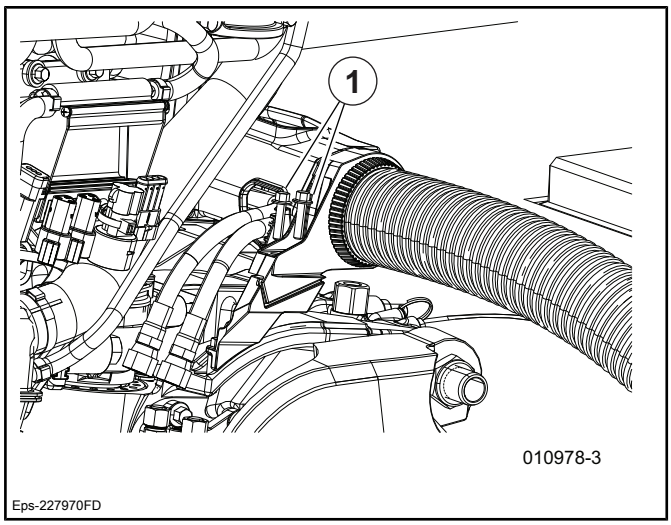
ENGINE IN VERTICAL POSITION

7. Disconnect the battery cables at the battery. Then disconnect all of the cables, the buss cables and the hoses from the engine.
8. Remove the flywheel thread plug from the flywheel threading.



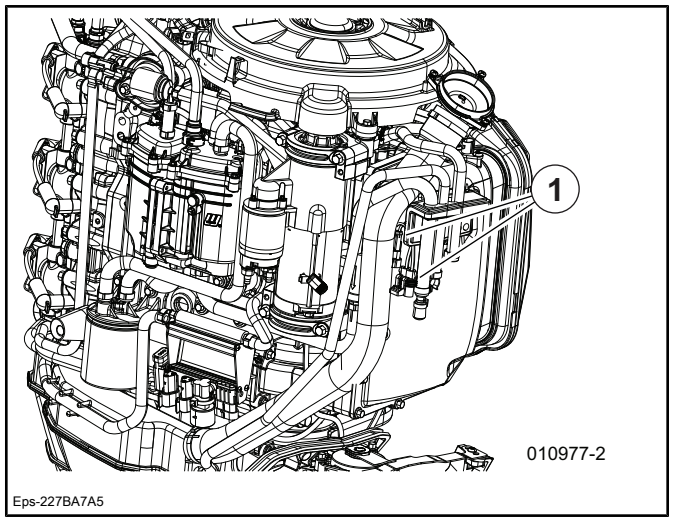
1. Flywheel thread plug

9. Remove the four screws retaining the rigging center. Then remove the rigging center.



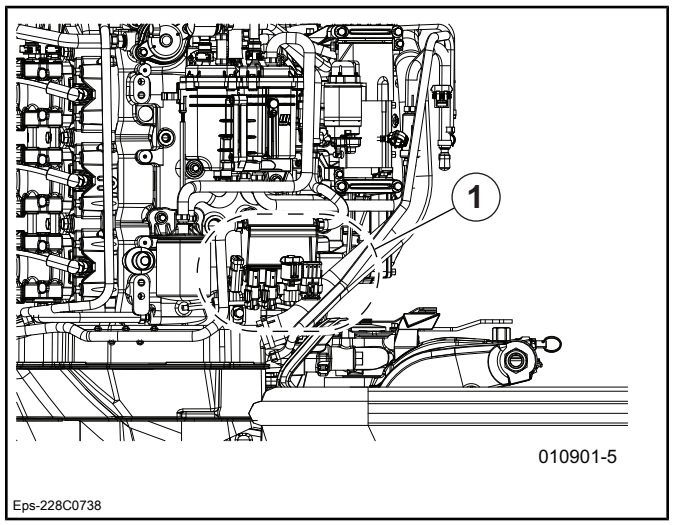
1. Rigging screws

10. Disconnect the electrical connectors for the trim motor and trim sender.



1. Trim motor and sender electrical connectors

11. Note the routing of the harnesses for the trim motor and trim sender.
12. Pull the harnesses back to the stern and swivel bracket.
13. If equipped, disconnect the electrical connectors from the DPS module.



1. DPS module connectors

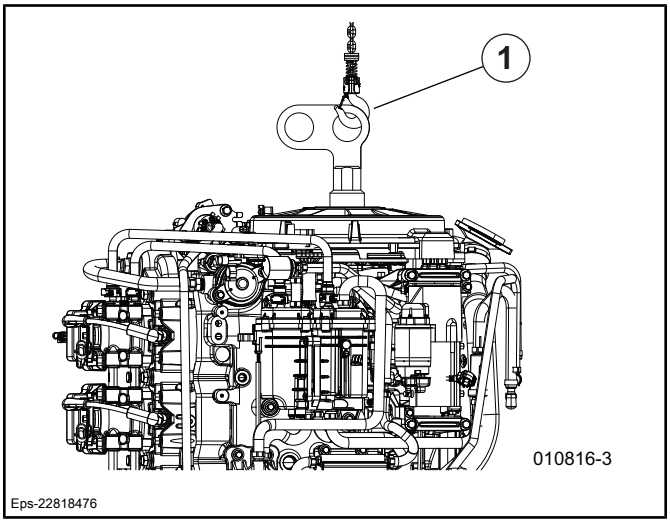
14. Note the routing of the harnesses for the DPS motor and sensor.
15. Pull the harnesses back to the stern and swivel bracket.
16. Install the lifting fixture completely into the flywheel threads. If needed, turn the flywheel until the lifting rings of the fixture are aligned front to back as shown.

IMPORTANT: Carefully thread the lifting fixture into the threads of the flywheel at least 6 complete turns. DO NOT cross-thread the threads of the lifting fixture into the threads of the flywheel.

Required Tool

Engine Lifting Fixture

P/N 357667

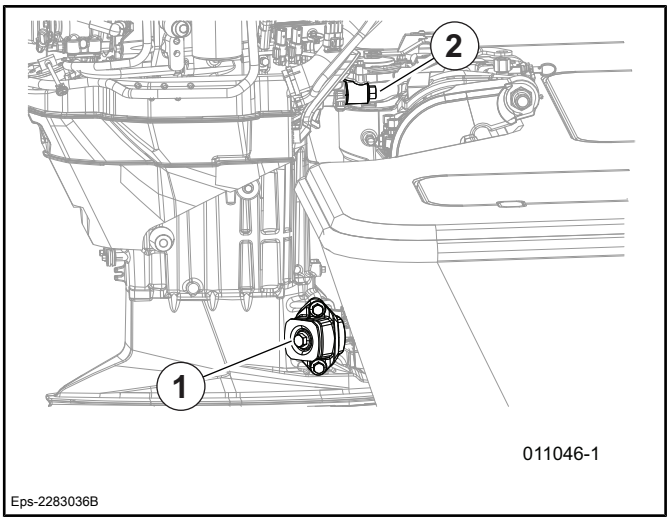


1. Lifting fixture, P/N 357667

⚠ WARNING

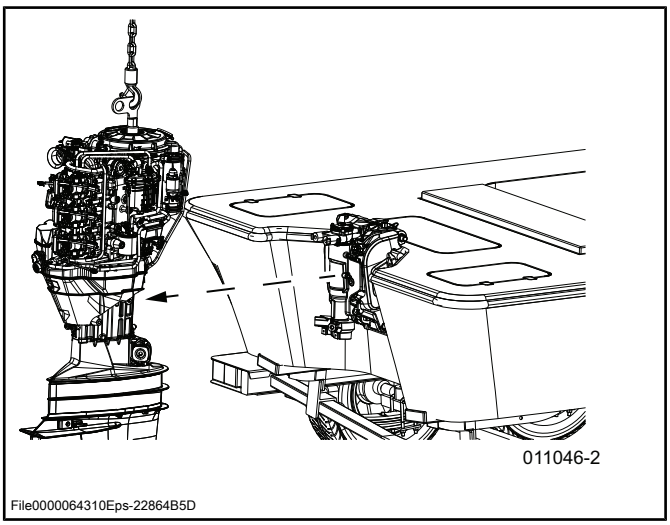
To avoid personal injury, make sure the lifting capacity of the hoist is at least twice the weight of the outboard.
DO NOT allow the lift hook or chain from the hoist to come in contact with any part of the engine during lifting.

17. Make sure the off-set lifting eye is aligned to the REAR of the engine.
18. Use the centered lifting eye to support the engine. Fasten an appropriate chain hook to the lifting eye.
19. Remove the two lower mount bolts from the lower steering bracket.
20. Remove the two upper mount bolts from the upper steering mount bracket.



1. Lower steering mount bolt
2. Upper steering mount bolt

21. Separate the supported engine from the stern and swivel assembly.
22. Swing the engine out of the way of the stern and swivel bracket.



23. Make note which mounting holes that were used for the upper steering mount bolts on the stern and swivel bracket assembly.
24. Remove the four mounting bolts.
25. Remove the stern and swivel assembly from the transom
26. Clean all old marine sealant from stern brackets and the transom of the boat.

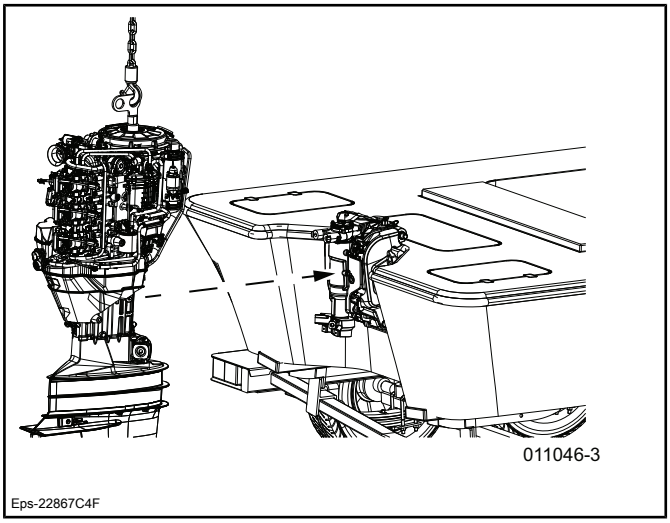
Stern and Swivel Bracket Installation

⚠ WARNING

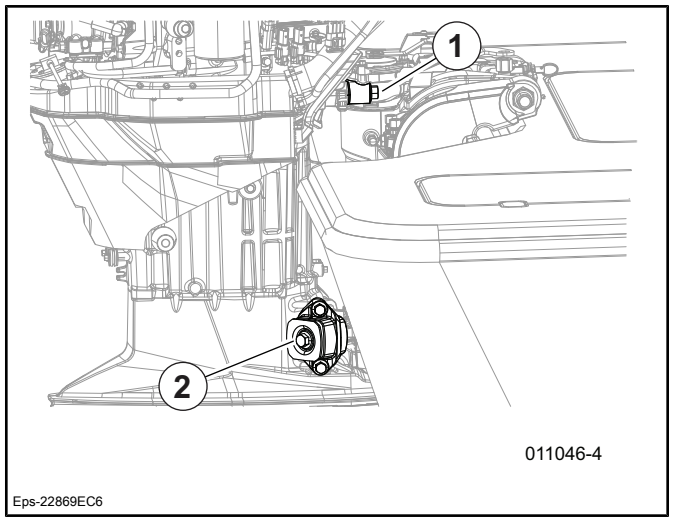
If either side of the transom deforms or cracks when the bolts are tightened to their recommended torque, the transom construction may not be adequate or may be deteriorated.
Structural failure of the transom could result in loss of boat control and injury to the occupants.

IMPORTANT: Use a marine sealant rated for above or below waterline use. RTV silicone is not approved for below waterline use. Polyurethane sealants are not easily removed and may damage outboard or boat mounting surfaces.

1. Apply marine sealer under hex heads of bolts, on the mounting plates, and to the bolt shanks.
2. Install the stern and swivel assembly with the four mounting bolts to the transom. Be sure to reinstall the top bolts in the same stern and swivel bracket assembly hole position as when removed.
3. Tighten mounting bolts and nuts to a torque of 40 ft. lbs. (54 N·m).
4. Align the engine assembly with the stern and swivel assembly.



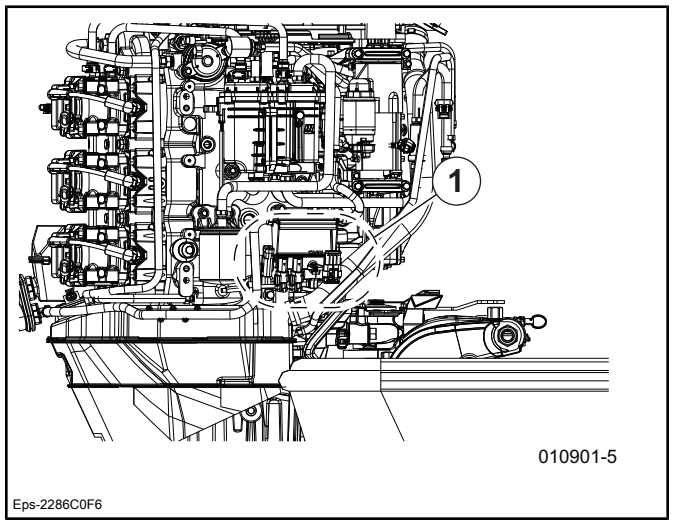
5. Secure the engine to the stern and swivel assembly with the two bolts for the upper steering mount bracket.
6. Secure the engine to the stern and swivel assembly with the two bolts to the lower steering mount bracket. Be sure the lower mount plates line up with the round protrusion of the lower mount.



1. Upper steering mount bolt
2. Lower steering mount bolt

7. Tighten the upper steering mount bolts to a torque of 57 to 59 ft. lbs. (77 to 80 N·m).
8. Tighten the lower steering mount bolts to a torque of 79 to 81 ft. lbs. (107 to 110 N·m).
9. If equipped, route the DPS harnesses to the DPS module. Connect the electrical connectors.

IMPORTANT: Verify that the DPS harness is routed through the front sealing grommet so that the alignment of the starboard frame with the front sealing grommet is intact.

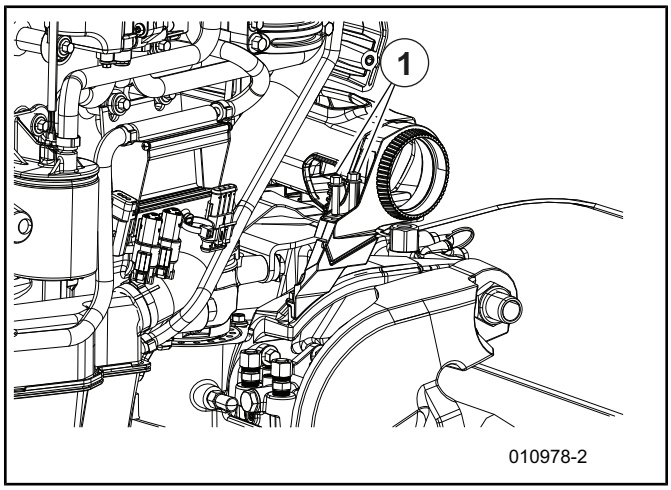


1. DPS module connectors

10. Route the harnesses for the trim motor and the trim sender to the starboard side of the engine. Connect the electrical connectors.

IMPORTANT: Verify that the trim and tilt harness is routed through the front sealing grommet so that the alignment of the starboard frame to the front sealing grommet is intact.

11. Install the rigging bracket, and secure with the four screws. Tighten the screws to a torque of 84 to 106 in. lbs. (10 to 12 N·m).

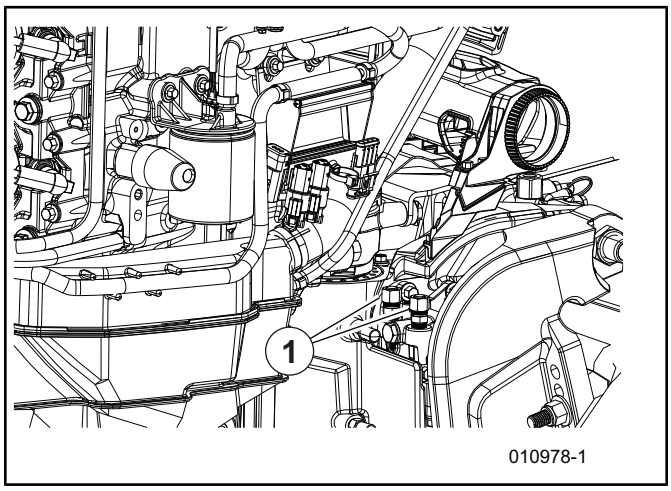


1. Rigging screws

12. Connect all of the cables, the buss cables and the hoses to the engine. Then connect the battery cables to the battery. Refer to **Rigging Information**.
13. Tilt the engine partially to gain easy access to the hydraulic steering hose installation.
14. Remove the plugs in the hydraulic hose fittings on the stern and swivel assembly. Connect the port hydraulic steering hose to the stern and swivel assembly.

NOTE: You cannot install the starboard steering hose until the port steering hose is installed.

15. Connect the starboard hydraulic steering hose to the stern and swivel assembly.



1. Plug and cap assembly

16. Use shop towels to clean up spilled steering fluid.

ENVIRONMENTAL NOTE

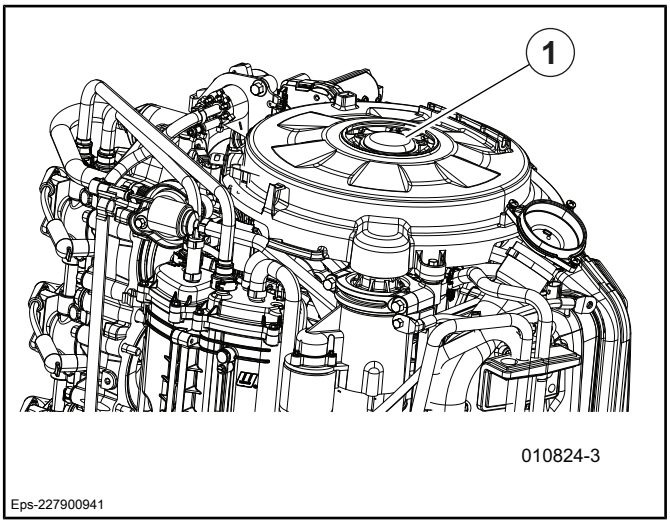
Dispose of contaminated shop towels according to local environmental regulations.

17. Remove the Engine Lifting Fixture, P/N 357667, from the flywheel.

NOTICE

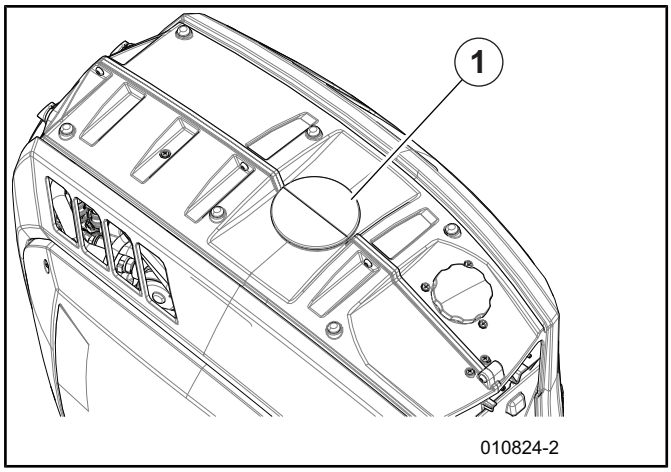
Install plugs as indicated. Plugs MUST be installed to prevent water entry and/or engine performance issues.
Make sure plugs are securely installed to prevent loosening during engine operation.

18. Install the flywheel thread plug into the flywheel threading.



1. Flywheel thread plug

19. Fill and bleed the hydraulic steering system.
20. Refer to **Filling and Bleeding the Hydraulic Steering System**.
21. Install the port and starboard frames, and the rear cover. Refer to **Engine Cover and Frame Service**.
22. Install the 4.5 inch plug into the center frame.



1. 4.5 inch plug

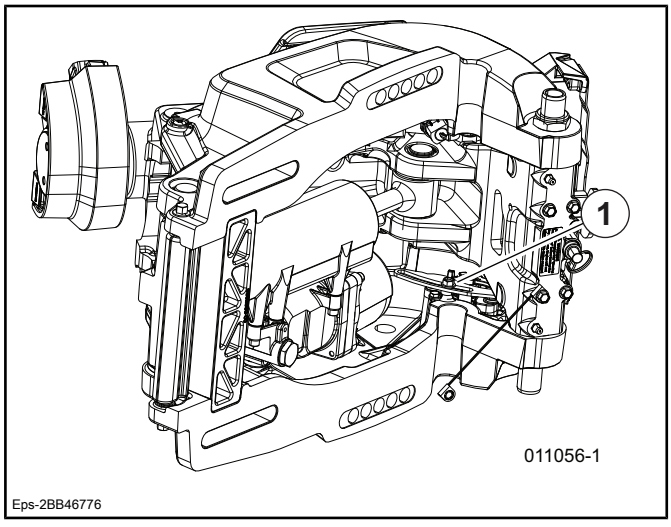
23. Install the top cover.

Stern Bracket Service

Stern Bracket Removal

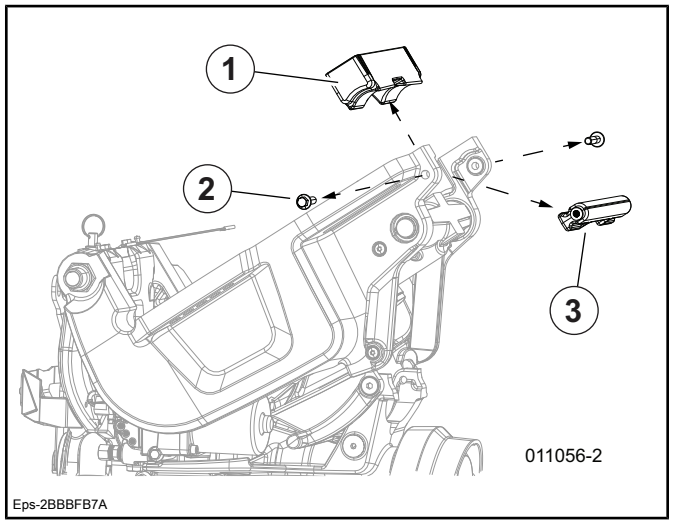
1. Remove the engine from the stern and swivel bracket assembly. Refer to **Stern and Swivel Bracket Removal**.
2. Remove the stern and swivel assembly from the boat.
3. Take the stern and swivel bracket assembly to a suitable work bench or area.
4. Use a suitable power source to trim the swivel bracket UP.

Trim the swivel bracket far enough to access the screw retaining the trim sender lever to the port stern bracket.



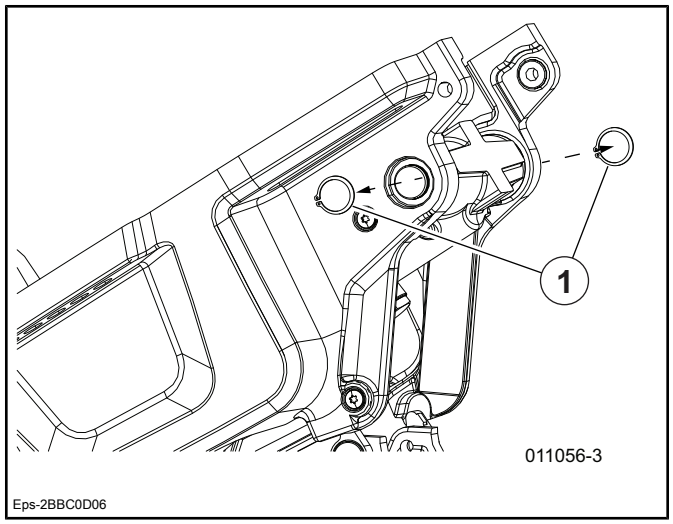
1. Trim sender lever screw

5. Remove the screw retaining the trim sender lever to the port stern bracket.
6. Remove the grommet.
7. Remove the two screws retaining the anode, then remove the anode.



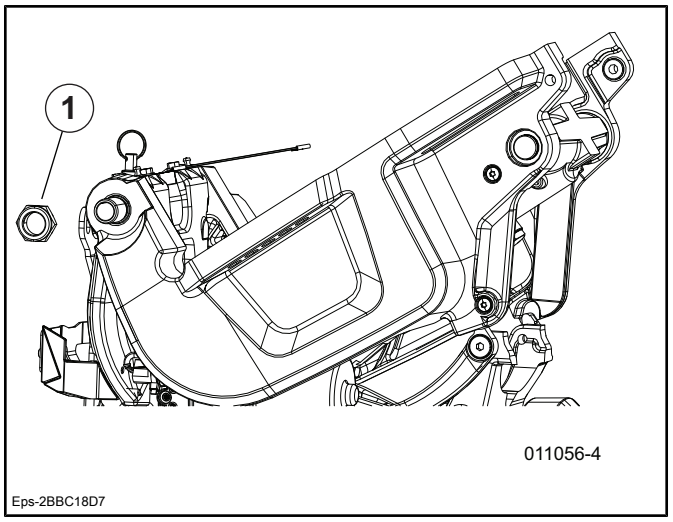
1. Grommet
2. Screws
3. Anode

8. Remove the two retaining rings from the lower tilt pin.



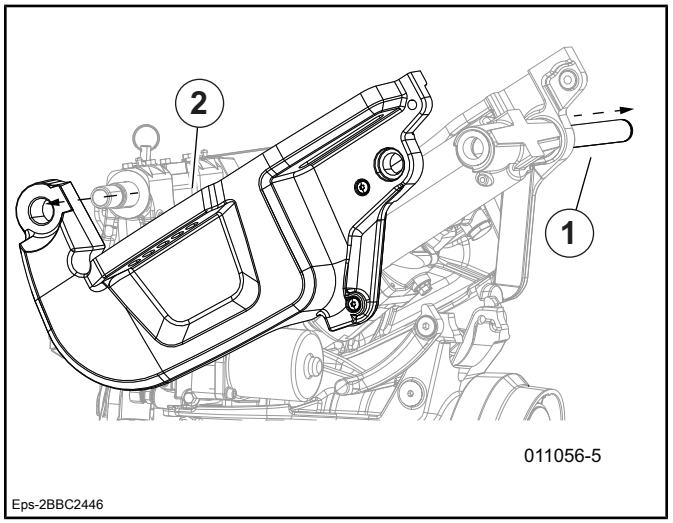
1. Retaining rings

9. Remove the tilt tube nut.



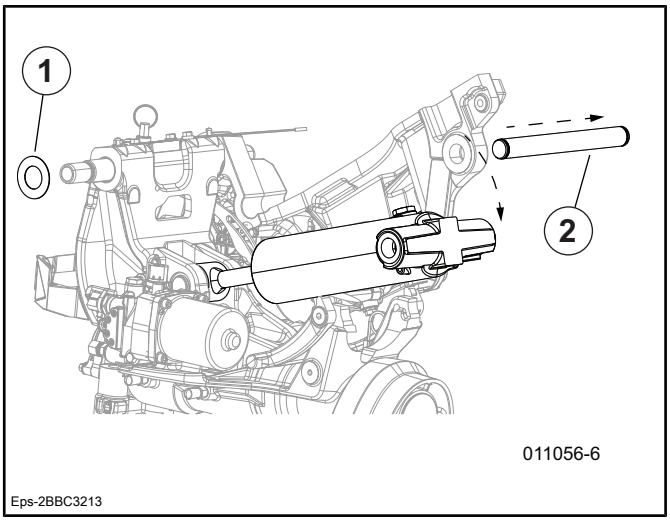
1. Tilt tube nut

10. While holding the starboard stern bracket, use a drift pin to push the lower tilt pin towards the port stern bracket until it disengages from the starboard stern bracket. Do NOT completely remove the tilt pin at this time.
11. Remove the starboard stern bracket from the tilt tube.



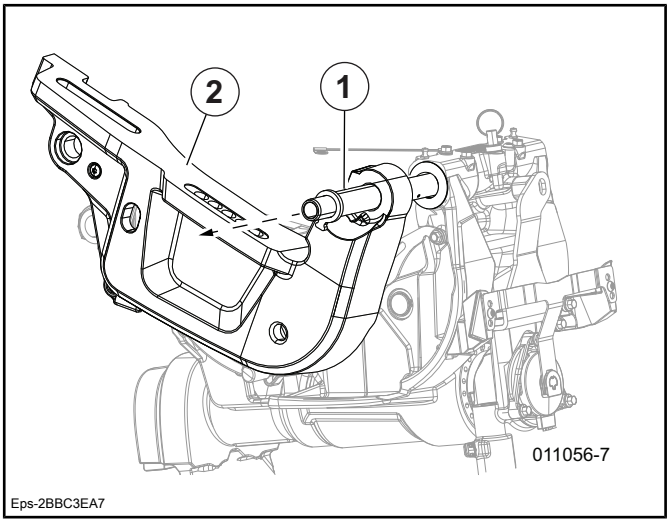
1. Lower tilt pin
2. Starboard stern bracket

12. Remove the thrust washer from the tilt tube.
13. While holding the trim and tilt hydraulic unit, remove the lower tilt pin. Then lower the hydraulic unit onto the swivel bracket.



1. Thrust washer
2. Lower tilt pin

14. While holding the port stern bracket, pull the tilt tube out of the swivel bracket slightly.
15. Remove the port stern bracket and tilt tube from the swivel bracket.

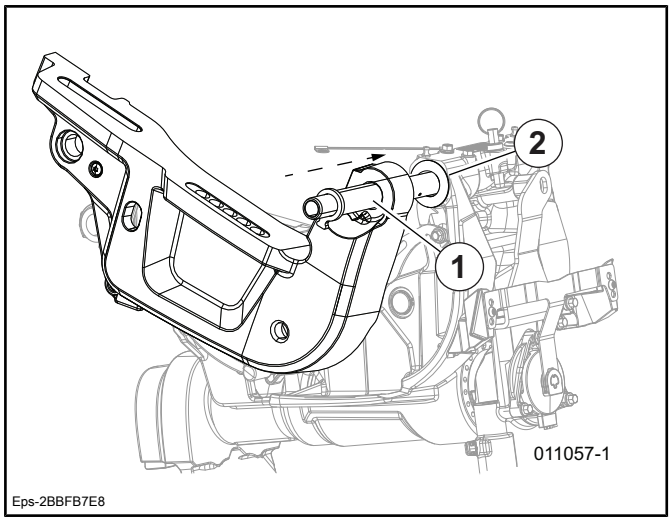


1. Tilt tube
2. Port stern bracket

16. Remove the port stern bracket from the tilt tube.

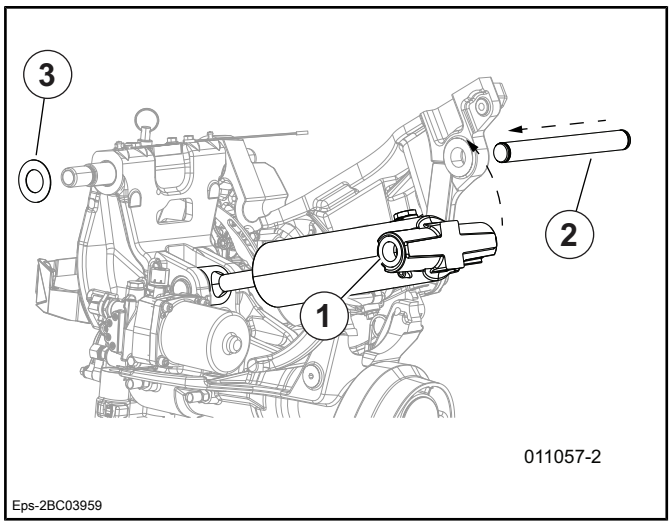
Stern Bracket Installation

1. Install the tilt tube through the port stern bracket.
2. Apply *Triple Guard* grease to the thrust washer.
3. Place the thrust washer over the tilt tube and install the assembly into the swivel bracket.



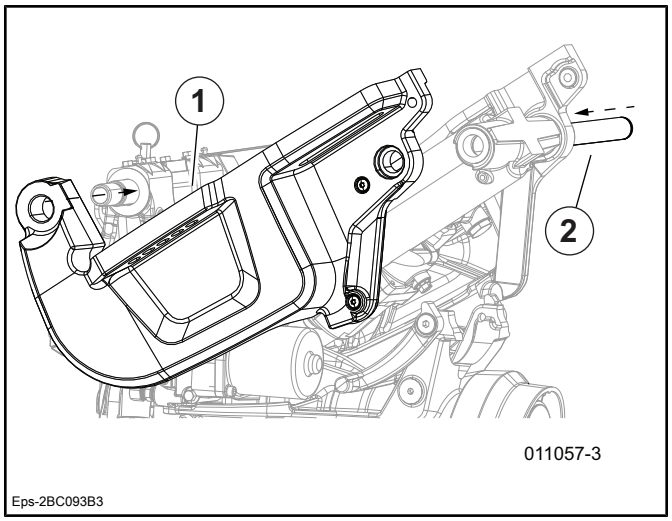
1. Tilt tube
2. Thrust washer

4. Apply *Triple Guard* grease to the two lower tilt pin bushings and install the bushings into the trim and tilt hydraulic unit.
5. Align the trim and tilt hydraulic unit with the port stern bracket and install the lower tilt pin.
6. Apply *Triple Guard* grease to the thrust washer and place the thrust washer on the tilt tube.



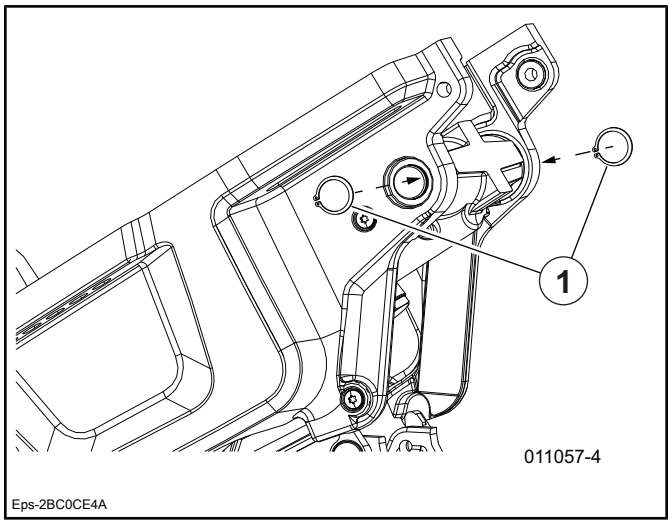
1. Tilt pin bushing (starboard side shown)
2. Tilt pin
3. Thrust washer

7. Install the starboard stern bracket onto the tilt tube.
8. Align the stern bracket with the trim and tilt hydraulic unit and install the tilt pin through the stern bracket.



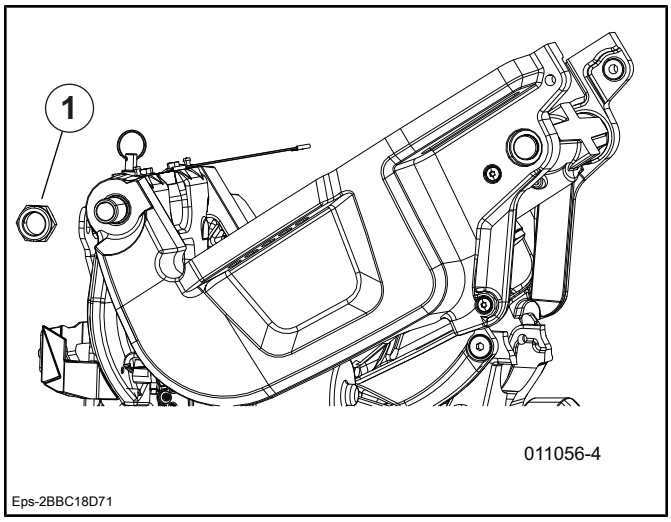
1. Starboard stern bracket
2. Tilt pin

9. Install the retaining rings onto the lower tilt pin.



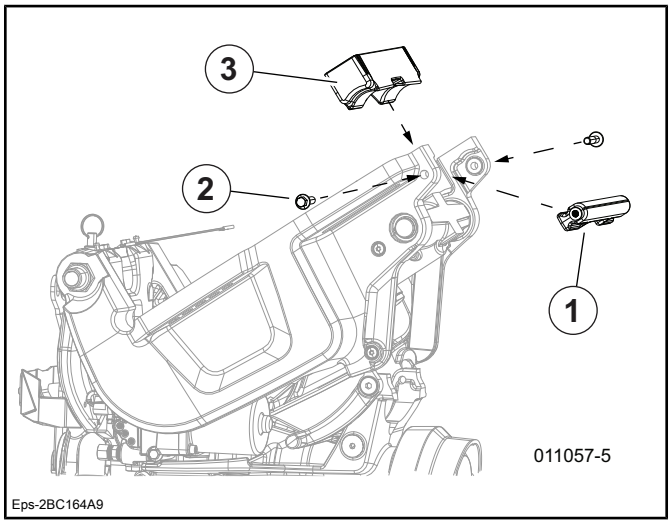
1. Retaining rings

10. Install the tilt tube nut on the tilt tube.
11. Tighten the nut to a torque of 40 to 50 Ft. lbs. (54.2 to 67.8 N·m).



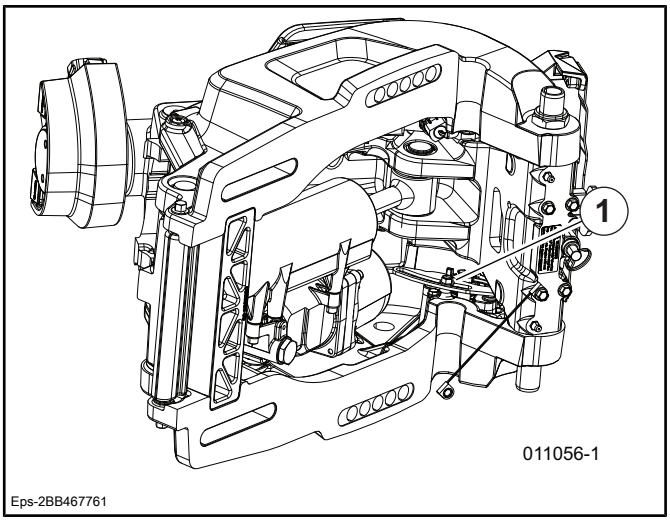
1. Tilt tube nut

12. Install the anode with two screws.
13. Tighten screws to a torque of 120 to 144 In. lbs. (13.5 to 16.2 N·m).
14. Install the grommet.



1. Anode
2. Two screws
3. Grommet

15. Install the retaining screw through the trim sender lever to the port stern bracket.
16. Tighten the screw to a torque of 24 to 36 In. lbs. (2.7 to 4 N·m)



1. Trim sender lever screw

17. Use a suitable power source to trim the swivel bracket to the vertical position.
18. Install the stern and swivel assembly on the boat.
19. Install the engine onto the stern and swivel bracket assembly. Refer to **Stern and Swivel Bracket Installation**.

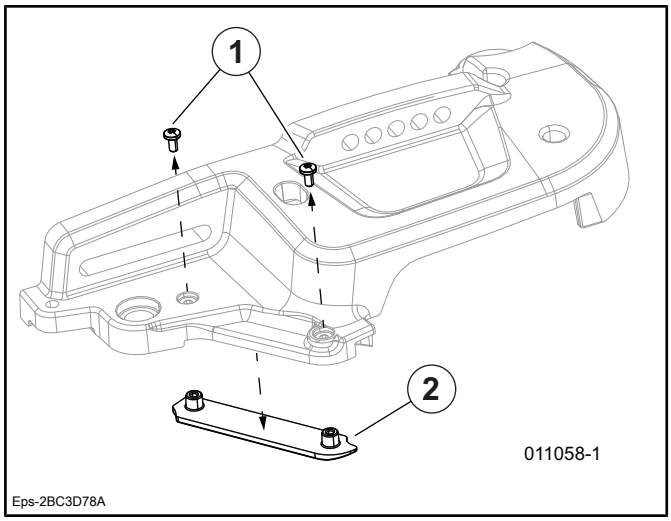
Trim Pad Service

⚠ WARNING

Avoid personal injury; always support the outboard's weight with a suitable hoist during service.

Trim pads can be serviced without removing the stern brackets from the outboard. Trim the outboard to the full UP position to service trim pads.

1. Remove the two retaining screws from the trim pad.
2. Remove the trim pad from the stern bracket.



1. *Two screws*
2. *Trim pad*

Installation is reverse of removal.

3. Install screws and tighten to a torque of 120 to 144 In. lbs. (13.5 to 16.2 N·m).

Trim Sender Service

Removal

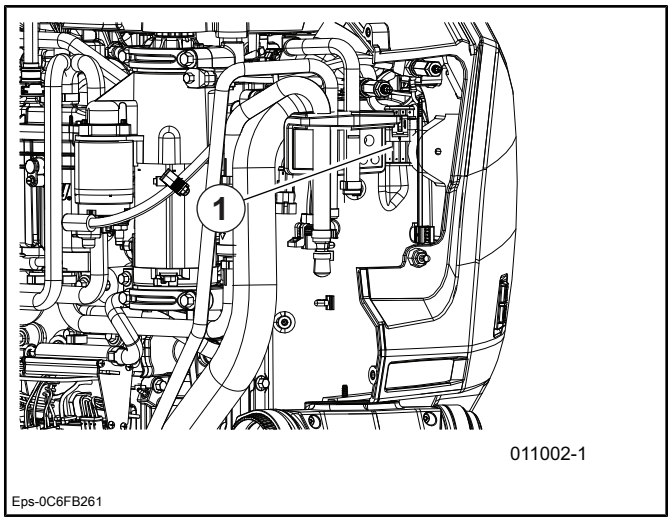
Servicing the trim sender requires removing the upper cover and starboard frame. Refer to **Engine Cover and Frame Service**.

Make note of the electrical wire routing of the trim sender prior to removal. Use a digital camera to take reference pictures as needed.

⚠ WARNING

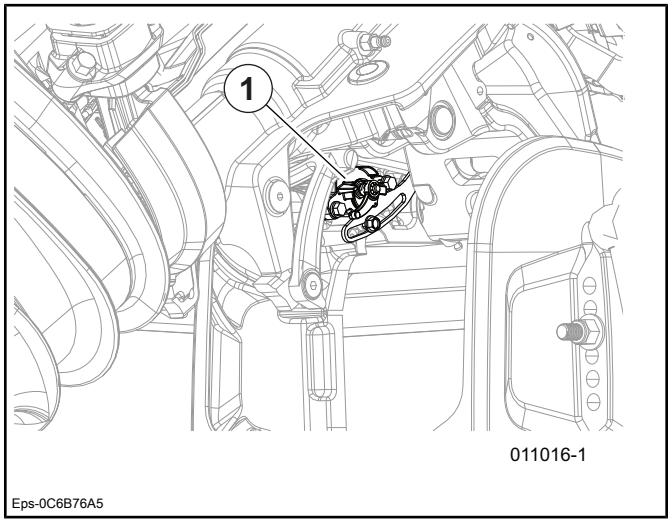
Support the outboard by the gearcase in the UP position, with a suitable hoist.
Avoid personal injury; always support the outboard's weight with a suitable hoist during service.

1. Tilt the outboard to the full UP position.
2. Disconnect the trim sender electrical connector.



1. *Trim sender electrical connector*

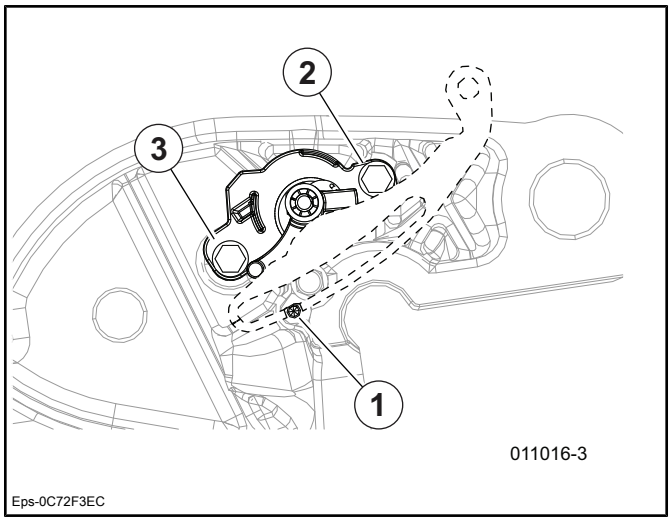
3. Remove the screws and washer from the sender.
4. Remove the screw from the ring terminal.
5. Then remove the trim sender from the swivel bracket.



1. *Trim sender*

Installation

1. Install the ring terminal (green wire) with one screw in the location shown. Tighten the screw to a torque of 24 to 36 In. lbs. (2.7 to 4 N·m).
2. Then position the trim sender on the swivel bracket.
3. Install the bonding lead on the upper screw. Then install a washer on the screw. Loosely install the screw to keep the trim sender in position.
4. Install the lower screw into the trim sender. Tighten both screws to a torque of 30 to 50 In. lbs. (3.4 to 5.6 N·m)



1. *Ring terminal location*
2. *Upper screw with binding lead*
3. *Lower screw*

Required Chemical
No-Ox Grease
P/N 768230

5. Apply *No-Ox Grease*, P/N 768230 over the ring terminal and screw.

Swivel Bracket Service

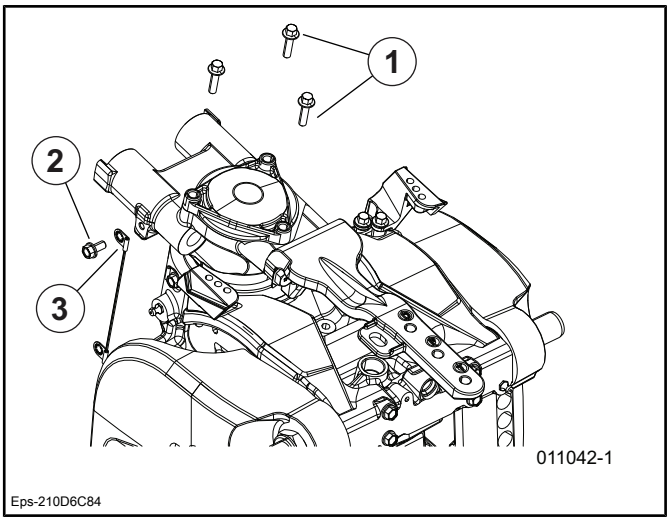
Non-DPS Swivel Bracket Service

Upper Steering Arm Removal

1. The engine must be separated from the stern and swivel bracket to remove the upper steering arm. Refer to **Stern and Swivel Bracket Removal**.

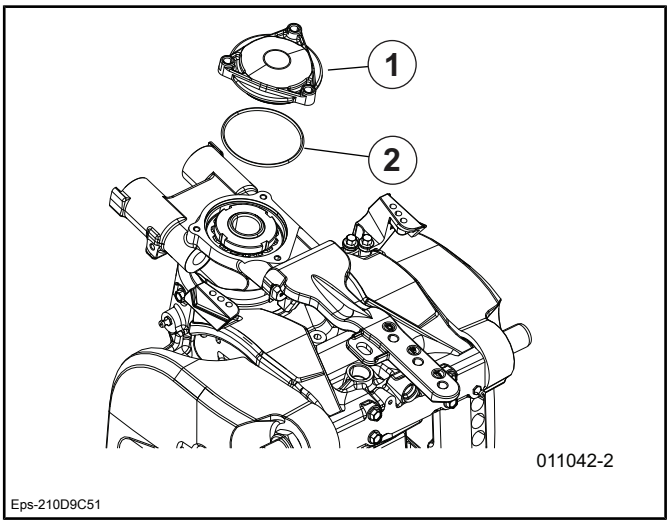
IMPORTANT: It is NOT necessary to completely de-rig the outboard, however the engine must be clear of the steering arm for removal. BE SURE to safely support the outboard during this procedure.

2. Remove the three screws from the steering arm cover.
3. Remove the screw from the bonding lead, then remove the bonding lead from the steering arm..



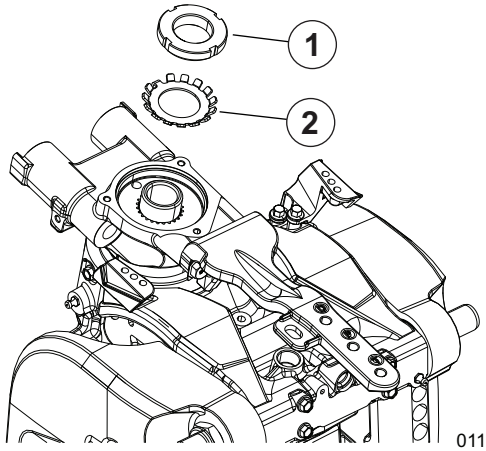
1. *Three cover screws*
2. *Screw*
3. *Bonding lead*

4. Remove the cover and O-ring



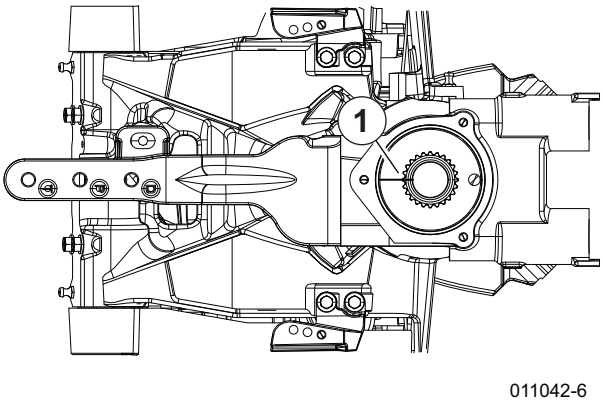
Required Tool
Spanner Socket
P/N 359224

5. Use Spanner Socket, P/N 359224, to remove the spanner nut.
6. Remove the locking washer.



1. Spanner nut
2. Locking washer

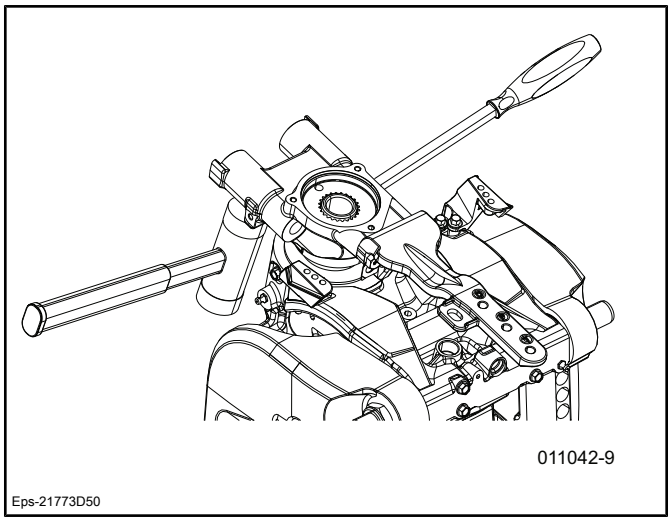
7. Make an alignment mark on the splined steering shaft and steering arm to aid re-assembly.



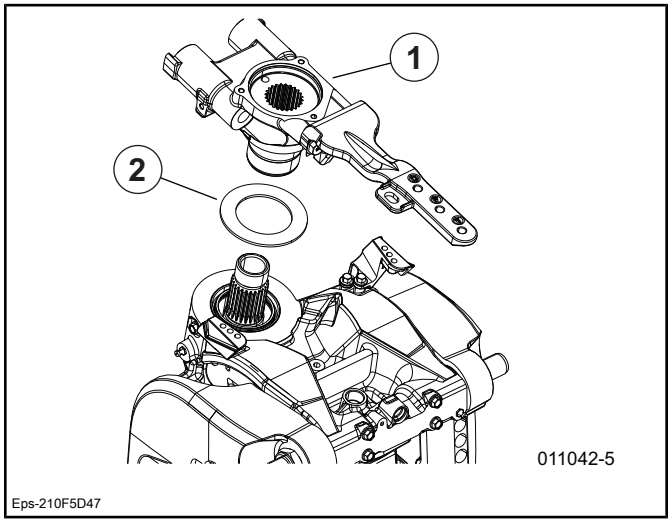
1. Alignment marks

The steering arm fits tight to the steering shaft. A helper may be needed to perform the next step.

8. CAREFULLY use a soft-faced mallet and a small pry bar to loosen the steering arm from the shaft.



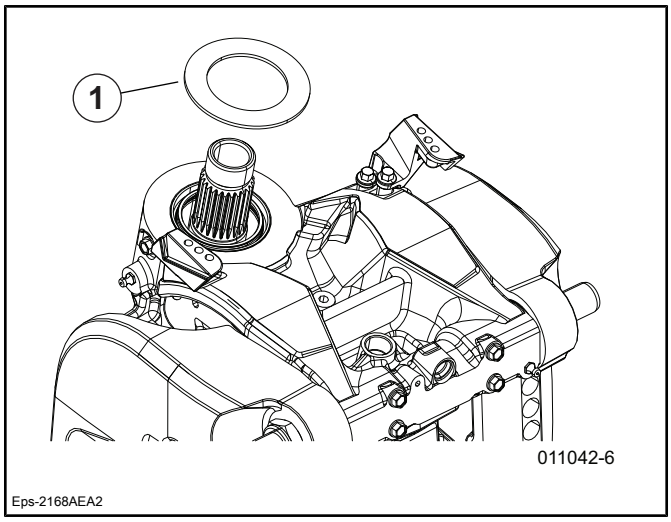
9. Remove the steering arm assembly and thrust washer from the steering shaft.



1. Steering arm assembly
2. Thrust washer

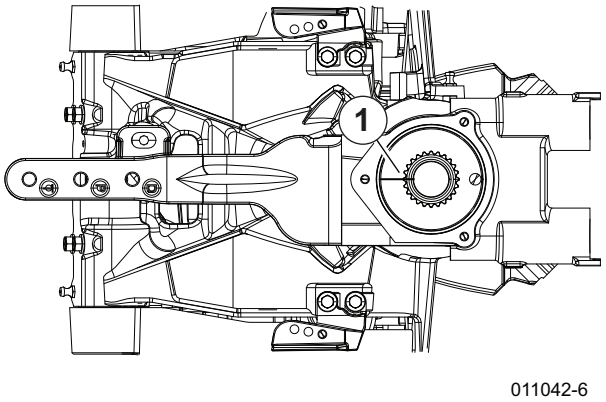
Upper Steering Arm Installation

1. Install the thrust washer onto the steering shaft.



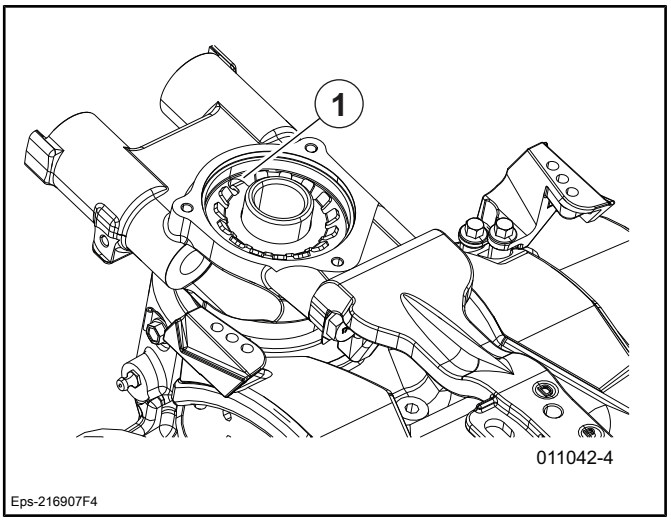
1. Thrust washer

2. Align the steering arm alignment mark with the alignment mark on the steering shaft.
3. Install the steering arm on the steering shaft.



1. Alignment marks

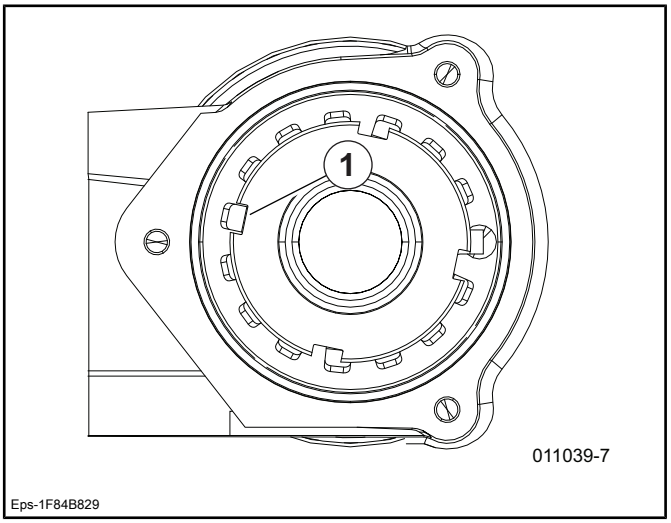
4. Place the locking washer over the steering shaft with the locating tab in the hole at the rear of the steering arm.



1. Locking tab

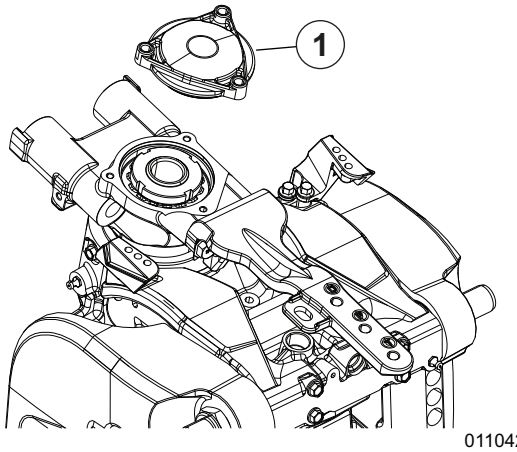
Required Tool
Spanner Socket
P/N 359224

5. Install the spanner nut on the shaft.
6. Use Spanner Socket, P/N 359224, to tighten the spanner nut to a torque of 59 to 70 Ft. Lbs. (80 to 94 N·m).
7. Continue tightening until any one slot of the spanner nut aligns with a tab on the locking washer. Do NOT exceed a torque of 70 Ft. Lbs. (94 N·m).



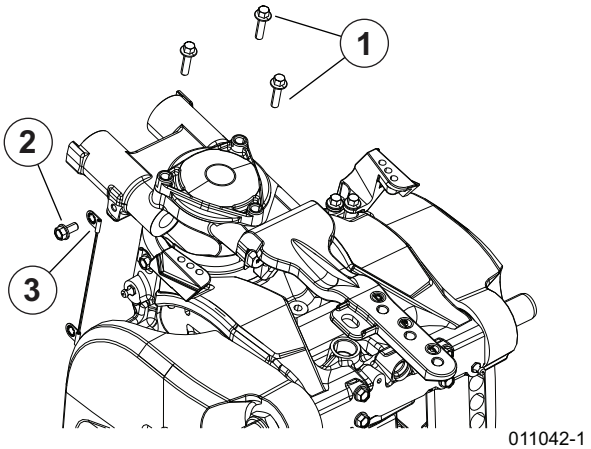
1. Slot aligned with tab

8. Apply *Triple Guard* grease Install a new o-ring and install the O-ring on the cover.
9. Install the cover and o-ring onto the swivel bracket.



1. Cover and o-ring

10. Install the bonding lead with one screw onto the steering arm. Tighten the screw to a torque of 24 to 36 In. lbs. (2.7 to 4 N·m).
11. Install the three cover screws. Tighten the screws to a torque of 72 to 96 In. lbs. (8.1 to 10.8 N·m).



1. Three cover screws
2. Screw
3. Bonding lead

12. Install the engine onto the stern and swivel bracket. Refer to **Stern and Swivel Bracket Installation**.

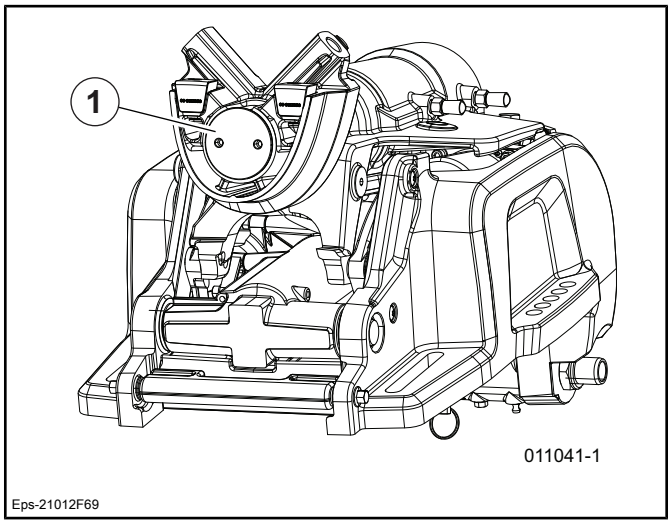
Lower Steering Arm Removal

1. The engine must be separated from the stern and swivel bracket to remove the lower steering arm. Refer to **Stern and Swivel Bracket Removal**.

IMPORTANT: It is not necessary to completely de-rig the outboard to remove the lower steering arm, however the engine must be clear of the steering arm for removal. BE SURE to safely support the outboard during this procedure.

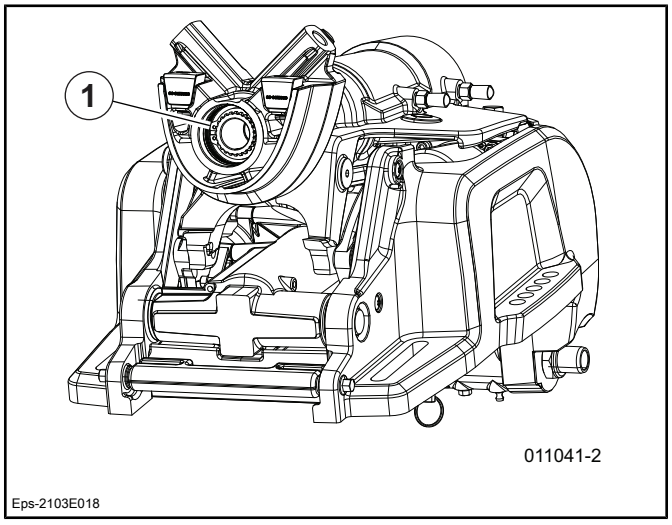
Required Tool
Spanner Wrench
P/N 912084

2. Use Spanner Wrench, P/N 912084, to remove the plug from the lower steering arm.



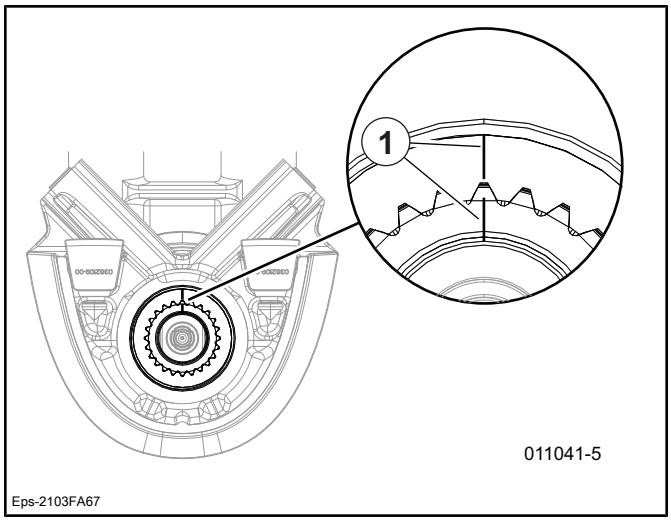
1. Plug

3. Use a pair of retaining ring pliers to remove the retaining ring from the shaft.

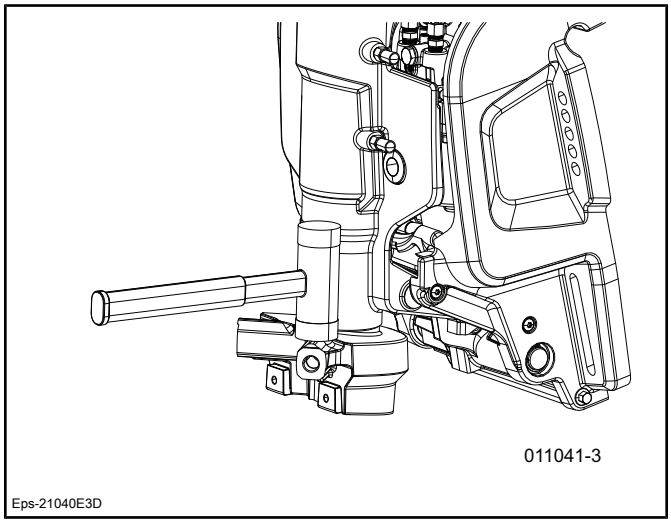


1. Retaining ring

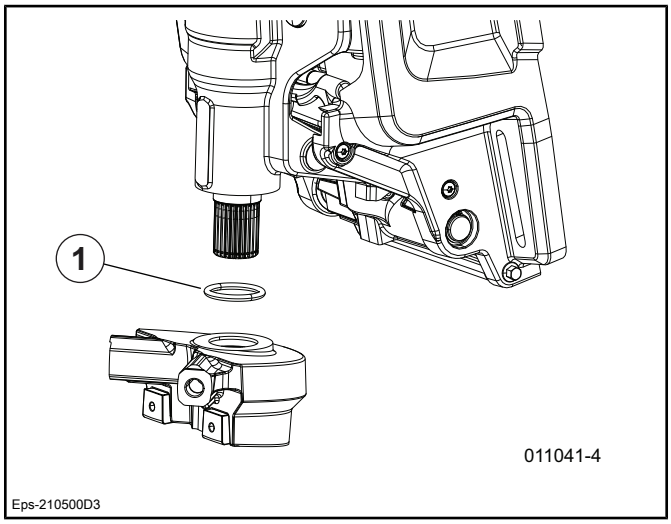
4. Make an alignment mark on the splined steering shaft and steering arm to aid re-assembly.



5. Use a soft face mallet to remove the steering arm from the steering shaft.



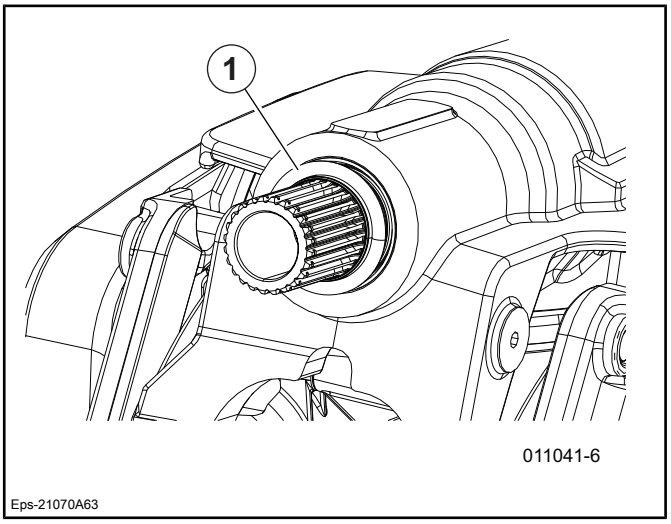
6. Remove the o-ring from the steering shaft.



1. O-ring

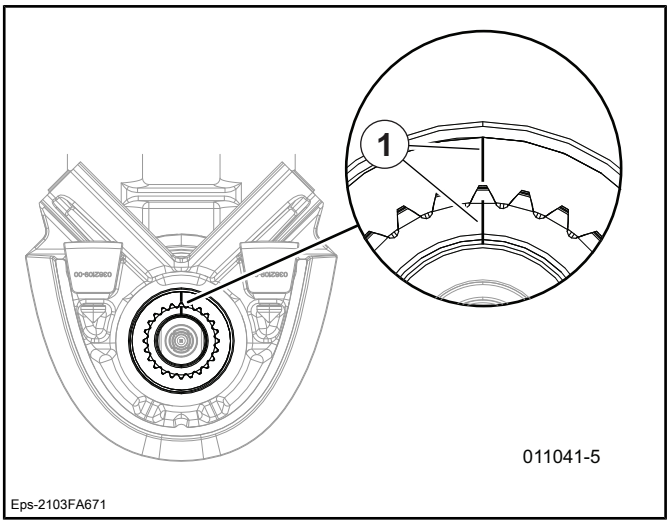
Lower Steering Arm Installation

1. Install a new o-ring on the steering shaft.



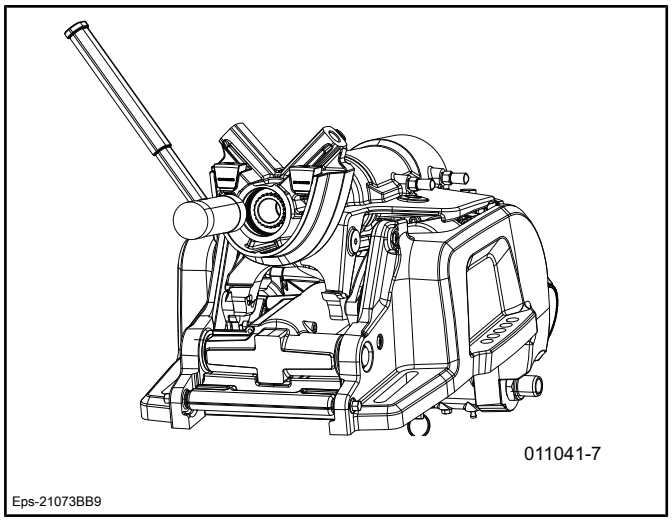
1. O-ring

2. Align the alignment marks of the steering arm and steering shaft then install the steering arm on the steering shaft.



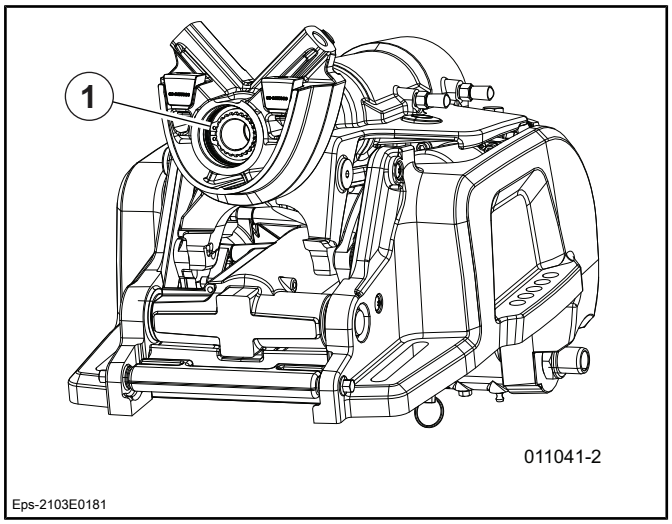
1. Alignment marks

3. If needed a soft-faced mallet may be used to seat the steering arm on the steering shaft.



4. Use a pair of retaining ring pliers to install the retaining ring.

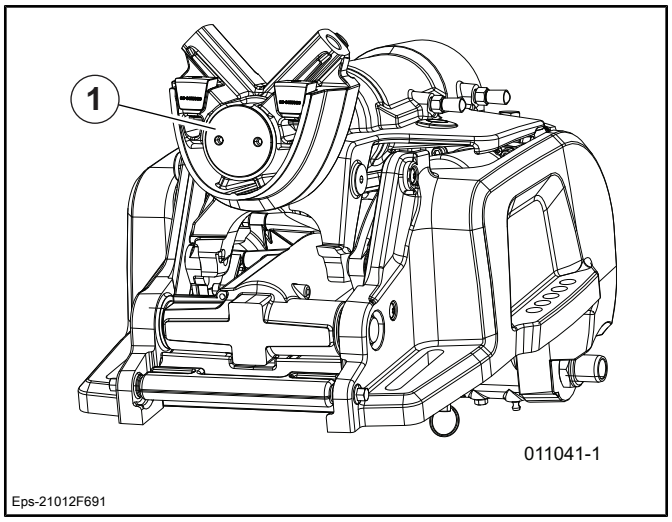
IMPORTANT: Make SURE the sharp edge of the retaining ring inner diameter is facing the plug.



1. Retaining ring

Required Tool
Spanner Wrench
P/N 912084

5. Use Spanner Wrench, P/N 912084, to install the plug. Tighten the plug to a torque of 60 to 84 in. lbs. (6.8 to 9.5 N·m).

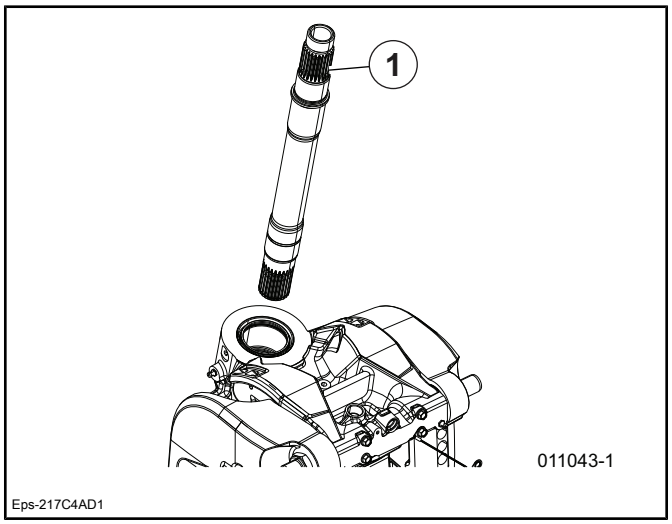


1. Plug

6. Install the engine onto the stern and swivel bracket. Refer to **Stern and Swivel Bracket Installation**.

Non-DPS Steering Shaft Removal

1. Remove the engine from the stern and swivel bracket. Refer to **Stern and Swivel Bracket Removal**.
2. Remove the upper steering arm. Refer to **Upper Steering Arm Removal**.
3. Remove the lower steering arm. Refer to **Lower Steering Arm Removal**.
4. Lift the steering shaft from the swivel bracket.



1. Steering shaft

5. Thoroughly clean the shaft with cleaning solvent and dry it with a clean lint-free shop towel.

Non-DPS Steering Shaft Installation

1. Remove the three screws from the steering arm cover.
2. Remove the cover and O-ring

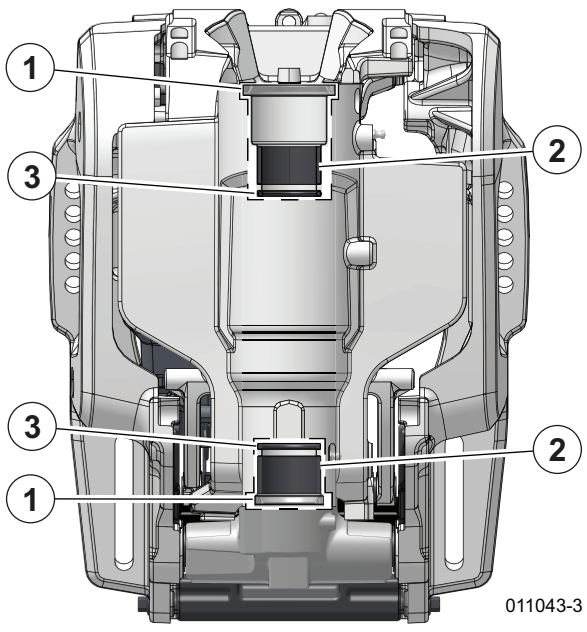
Required Tool
Spanner Socket
P/N 359224

3. Use Spanner Socket, P/N 359224, to remove the spanner nut.
4. Remove the locking washer.
5. Make an alignment mark on the splined steering shaft and steering arm to aid re-assembly.
6. Remove the steering arm from the steering shaft.

Non-DPS Swivel Bracket Service

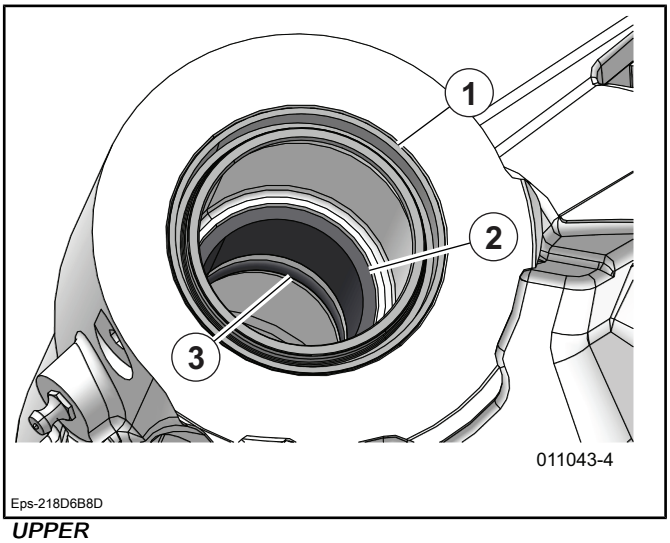
1. Remove the engine from the stern and swivel bracket. Remove the stern and swivel bracket from the boat. Refer to **Stern and Swivel Bracket Removal**.
2. Remove the upper steering arm. Refer to **Upper Steering Arm Removal**.
3. Remove the lower steering arm. Refer to **Lower Steering Arm Removal**.
4. Remove the steering shaft. Refer to **Non-DPS Steering Shaft Removal**.

   The bore of the steering shaft contains upper and lower seals, bearings and o-rings.

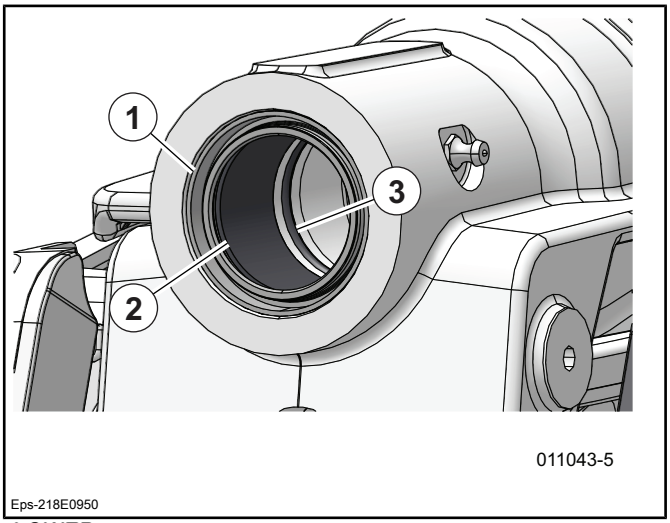


UPPER AND LOWER CUT-AWAY VIEWS
1. *Seal*
2. *Bearing*
3. *O-ring*

5. Use an appropriate seal remover, such as a 2–Jaw puller and slide hammer to remove the seals.
6. Use a long pick to remove the bearings and o-rings.



UPPER
1. *Seal*
2. *Bearing*
3. *O-ring*



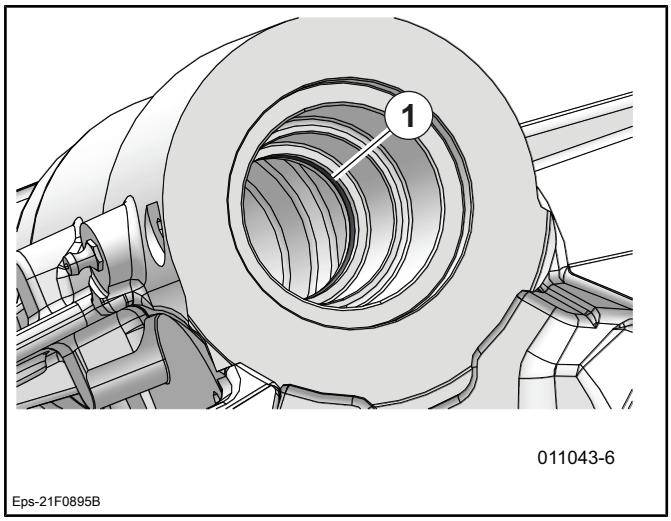
LOWER
1. *Seal*
2. *Bearing*
3. *O-rng*

7. Thoroughly clean the steering shaft bore with cleaning solvent and dry it with compressed air and/or a clean lint-free shop towel.

IMPORTANT: Take care NOT to allow solvent onto painted areas. Some solvents may damage painted surfaces.

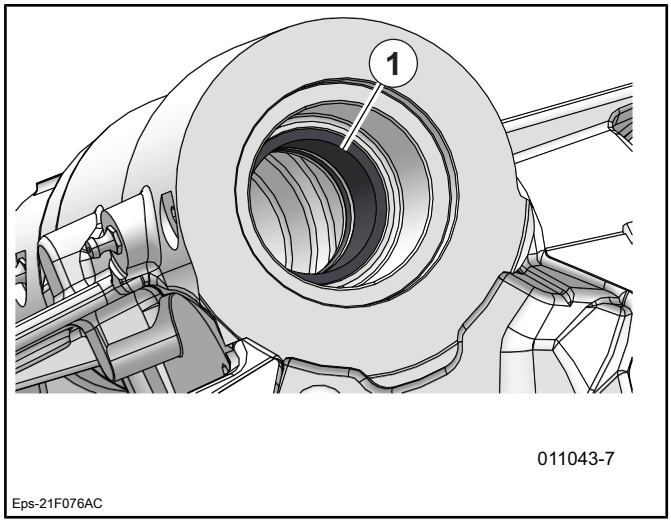
Install new o-rings, bearings and seals as needed.

8. Lightly apply *Triple Guard* grease to new o-rings.
9. Install o-rings in their retaining grooves.



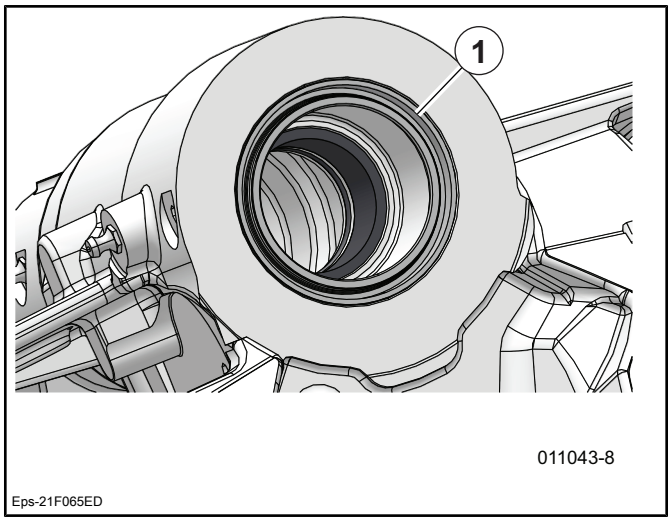
1. O-ring (upper shown)

10. Apply *Triple Guard* grease to the bearings and install the bearings into the swivel bracket.



1. Bearing (upper shown)

11. Install the upper and/or lower seals into swivel bracket, with the lips of the seal facing out.
    1. Use P/N to install the upper seal
    2. Use P/N to install the lower seal



1. Seal (upper shown)

12. Install the steering shaft. Refer to **Non-DPS Steering Shaft Installation**.
13. Install the lower steering arm. Refer to **Lower Steering Arm Installation**.
14. Install the upper steering arm. Refer to **Upper Steering Arm Installation**.
15. Install the stern and swivel bracket on the boat. Install the engine onto the stern and swivel bracket. Refer to **Stern and Swivel Bracket Installation**.

DPS Swivel Bracket Service

Upper DPS Steering Arm Removal

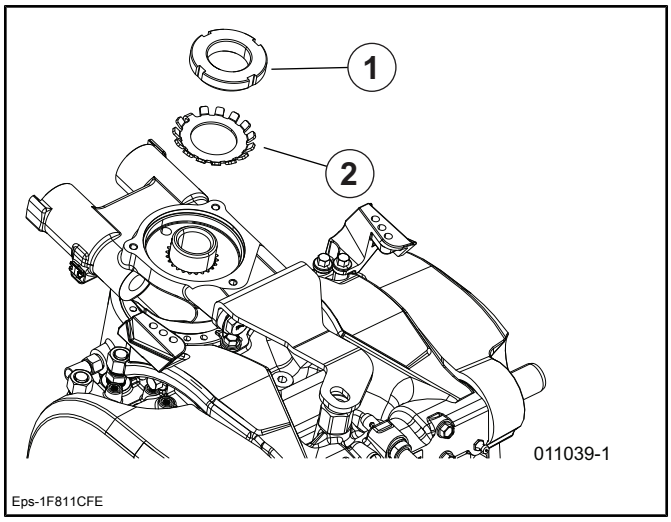
1. The engine must be separated from the stern and swivel bracket to remove the upper steering arm. Refer to **Stern and Swivel Bracket Removal**.

IMPORTANT: It is NOT necessary to completely de-rig the outboard, however the engine must be clear of the steering arm for removal. BE SURE to safely support the engine during this procedure.

2. Remove the steering position sensor. Refer to **Steering Position Sensor Service**.

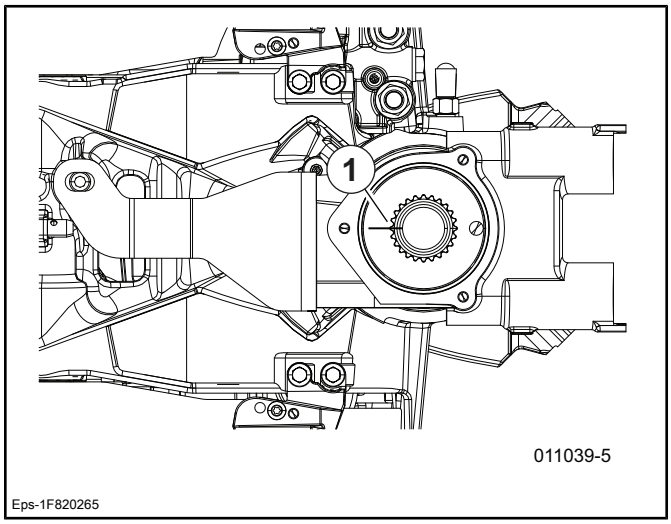
Required Tool
Spanner Socket **P/N 359224**

3. Use Spanner Socket, P/N 359224, to remove the spanner nut.
4. Remove the locking washer.



1. Spanner nut
2. Locking washer

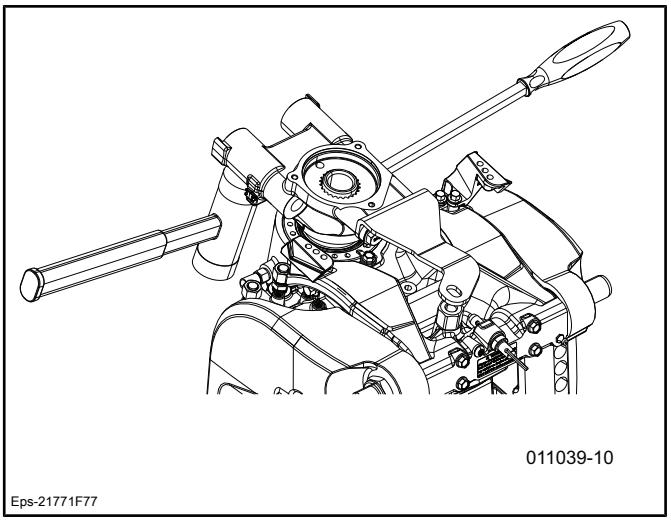
5. Make an alignment mark on the splined steering shaft and steering arm to aid re-assembly.



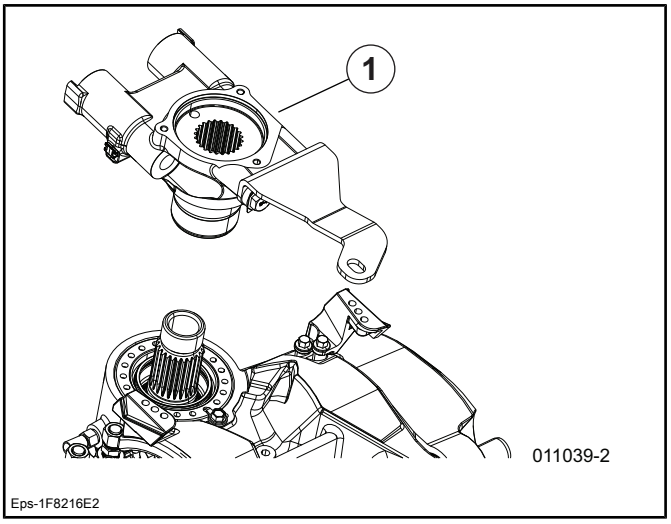
1. Alignment mark

The steering arm fits tight to the steering shaft. A helper may be needed to perform the next step.

6. CAREFULLY use a soft-faced mallet and a small pry bar to loosen the steering arm from the shaft.



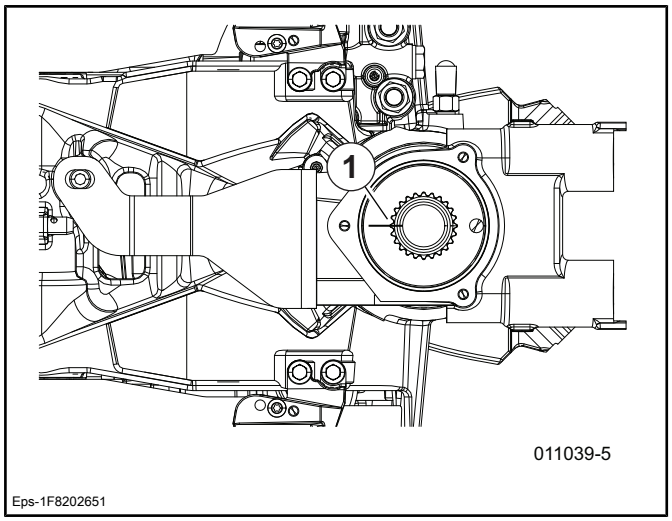
7. Remove the steering arm from the steering shaft.



1. Steering arm assembly

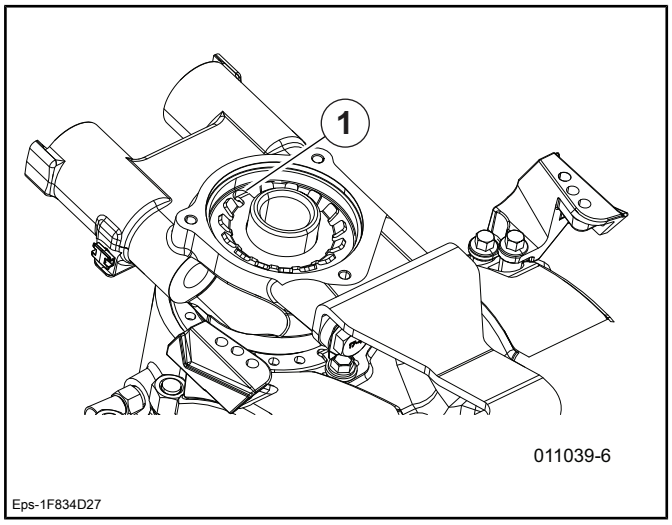
Upper DPS Steering Arm Installation

1. Align the steering arm alignment mark with the alignment mark on the steering shaft.
2. Install the steering arm on the steering shaft.



1. Alignment mark

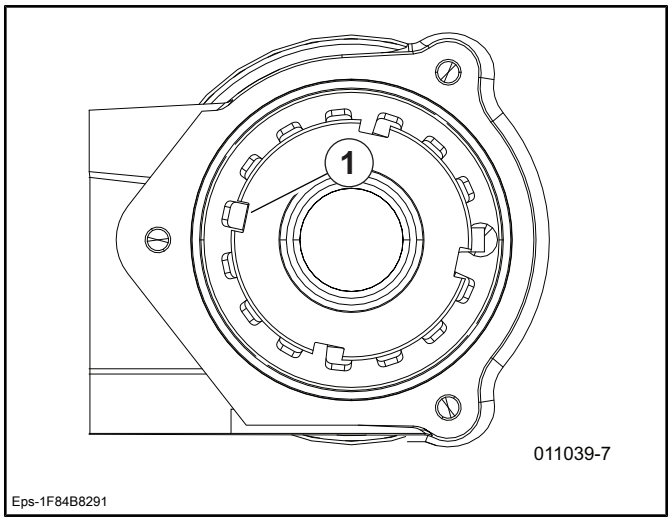
3. Place the locking washer over the steering shaft with the locating tab in the hole at the rear of the steering arm.



1. Locating tab

Required Tool
Spanner Socket
P/N 359224

4. Install the spanner nut on the shaft.
5. Use Spanner Socket, P/N 359224, to tighten the spanner nut to a torque of 59 to 70 Ft. Lbs. (80 to 94 N·m).
6. Continue tightening until any one slot of the spanner nut aligns with a tab on the locking washer. Do NOT exceed a torque of 70 Ft. Lbs. (94 N·m).



1. Slot aligned with tab

7. Install the steering position sensor. Refer to **Steering Position Sensor Service**.
8. Install the engine onto the stern and swivel bracket. Refer to **Stern and Swivel Bracket Installation**.

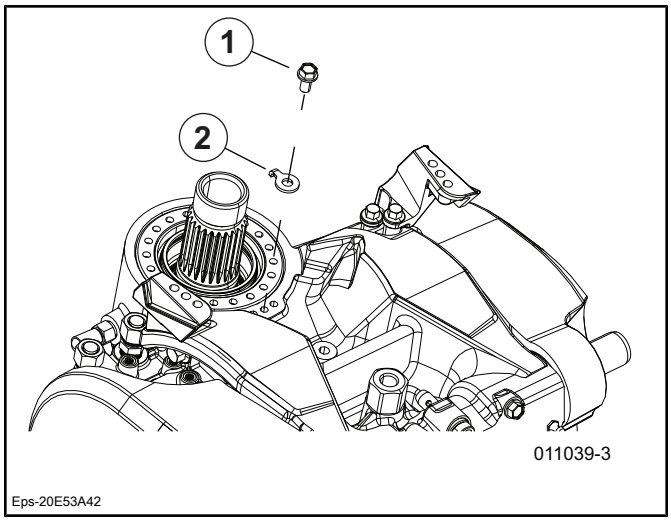
End Cap Removal

The end cap assembly contains no serviceable parts and must be replaced as an assembly. Remove the end cap only if replacement is required.

1. The engine must be separated from the stern and swivel bracket to remove the upper steering arm and end cap. Refer to **Stern and Swivel Bracket Removal**.

IMPORTANT: It is NOT necessary to completely de-rig the outboard, however the engine must be clear of the steering arm for removal. BE SURE to safely support the engine during this procedure.

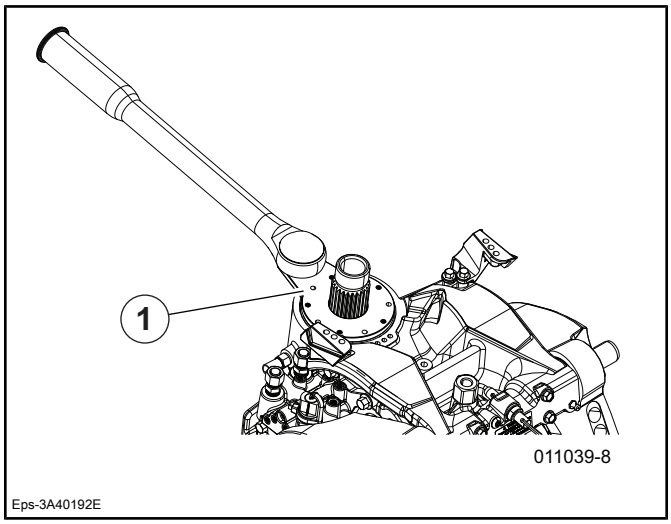
2. Remove the steering position sensor. Refer to **Steering Position Sensor Service**.
3. Remove the upper steering arm from the steering shaft. Refer to **Upper DPS Steering Arm Removal**.
4. Remove the screw and retaining tab from the swivel bracket.



1. Screw
2. Retaining tab

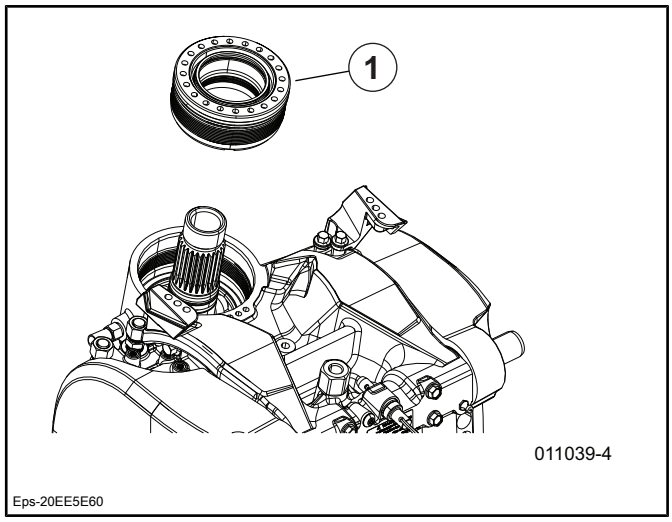
Required Tool
Spanner Wrench
P/N 362856

5. Use Spanner Wrench, P/N 362856, to remove the end cap assembly.



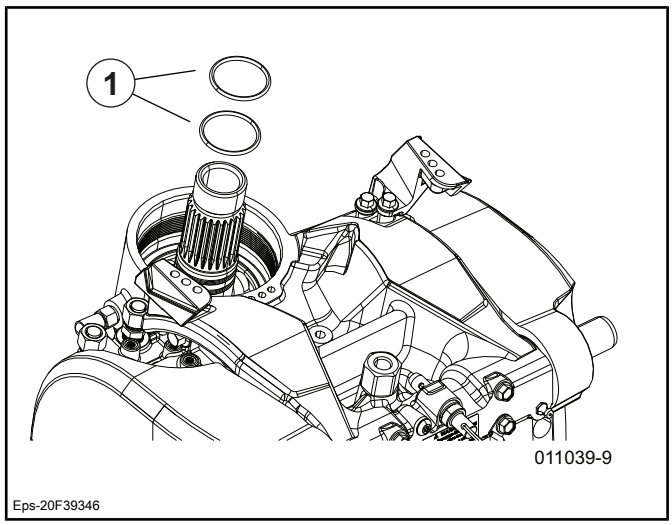
1. Spanner Wrench, P/N 362856

6. Remove the end cap assembly from the swivel bracket.



1. End cap assembly

7. Remove the two o-rings from the shaft.



1. O-rings

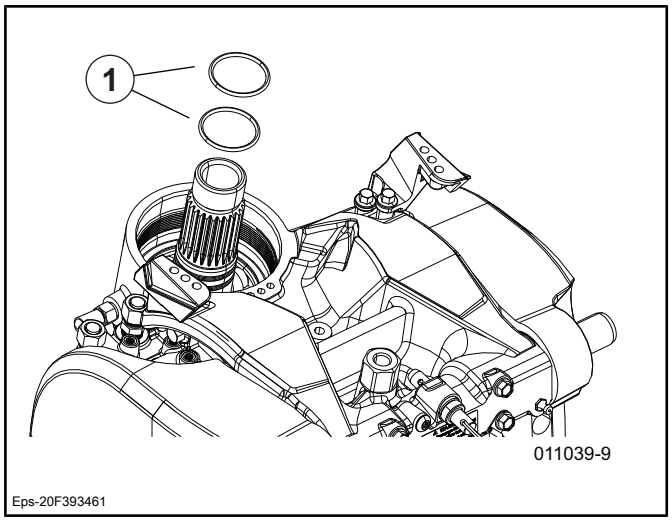
End Cap Installation

The end cap assembly contains no user serviceable parts and must be replaced as an assembly. Refer to the correct engine model in the Electronic Parts Catalog (EPC) to order the correct kit.

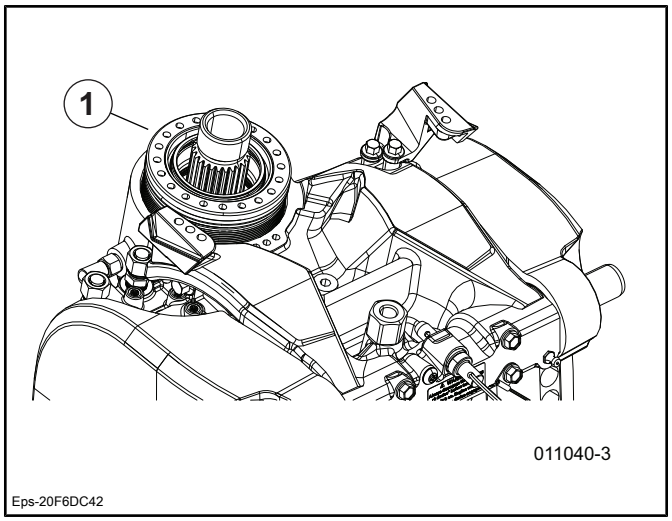
1. Remove the two steering shaft o-rings from the end cap service kit.

Required Chemical
Hydraulic Steering Fluid
P/N 770891

2. Apply Hydraulic Steering Fluid, P/N 770891, to the two new O-rings.
3. Install the O-rings on the steering shaft.



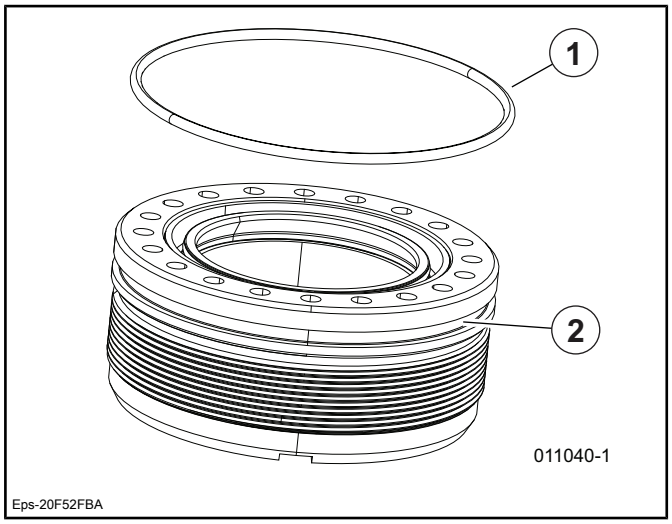
1. O-rings



1. End cap assembly

Required Chemical
Triple Guard Grease
P/N 508298

4. Apply *Triple Guard Grease* to a new end cap O-ring, and install the O-ring in the groove in the end cap.

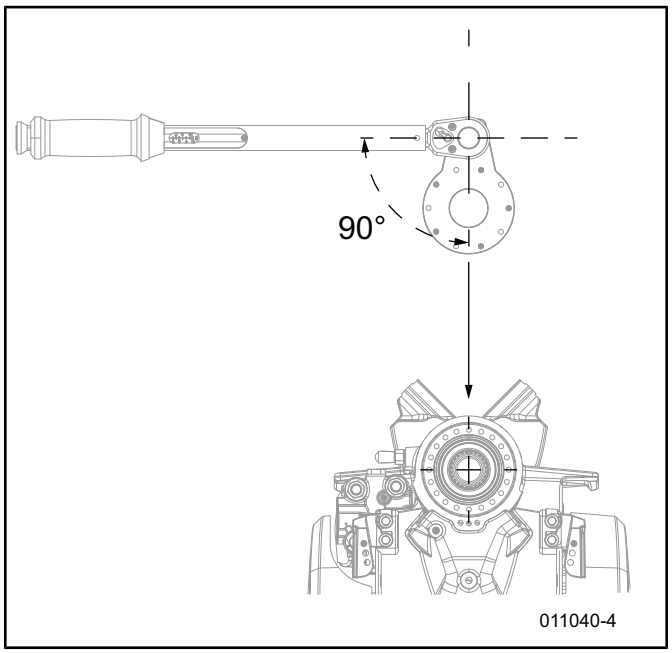


1. O-ring
2. Groove in end cap

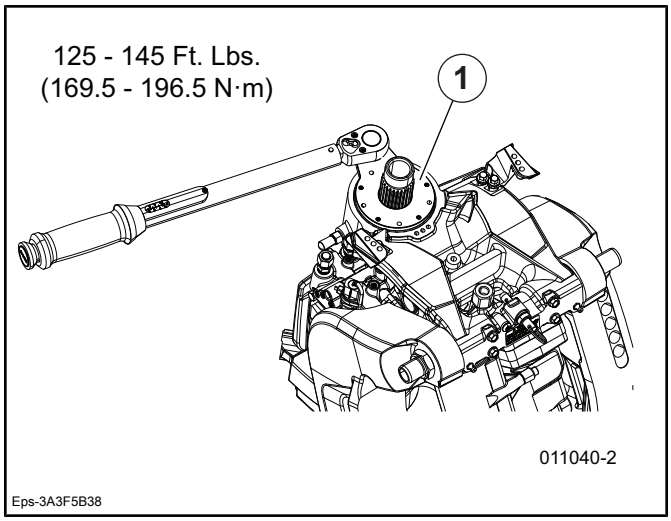
5. Install the end cap assembly over the steering shaft and hand tighten to prevent cross-threading the end cap.

Required Tool
Spanner Wrench
P/N 362856

6. Use Spanner Wrench, P/N 362856, to install the end cap assembly. Install the tool on the torque wrench at a 90° angle as shown. Be SURE to keep the tool and torque wrench in this orientation during installation, to ensure correct torque is applied to the end cap.



7. Tighten the end cap to a torque of 125 - 145 Ft. Lbs. (169.5 - 196.5 N·m).



1. Spanner Wrench, P/N 362856

8. Install the upper steering arm on the steering shaft. Refer to **Upper DPS Steering Arm Installation**.
9. Install the steering position sensor. Refer to **Steering Position Sensor Service**.
10. Install the engine onto the stern and swivel bracket. Refer to **Stern and Swivel Bracket Installation**.

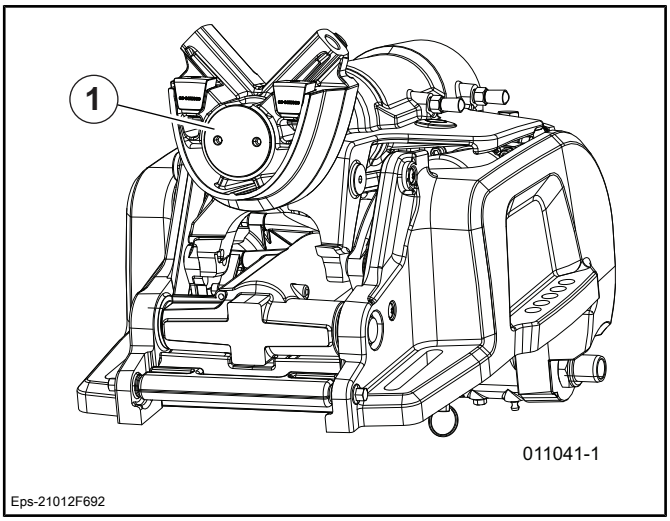
Lower Steering Arm Removal

1. The engine must be separated from the stern and swivel bracket to remove the lower steering arm. Refer to **Stern and Swivel Bracket Removal**.

IMPORTANT: It is not necessary to completely de-rig the outboard to remove the lower steering arm, however the engine must be clear of the steering arm for removal. BE SURE to safely support the outboard during this procedure.

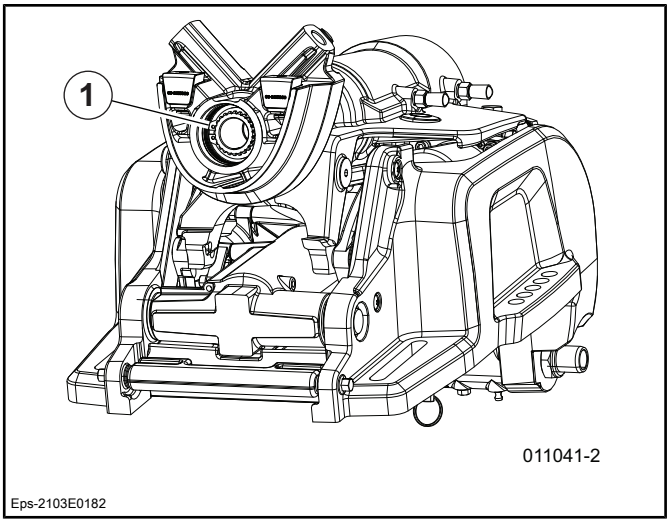
Required Tool
Spanner Wrench **P/N 912084**

2. Use Spanner Wrench, P/N 912084, to remove the plug from the lower steering arm.



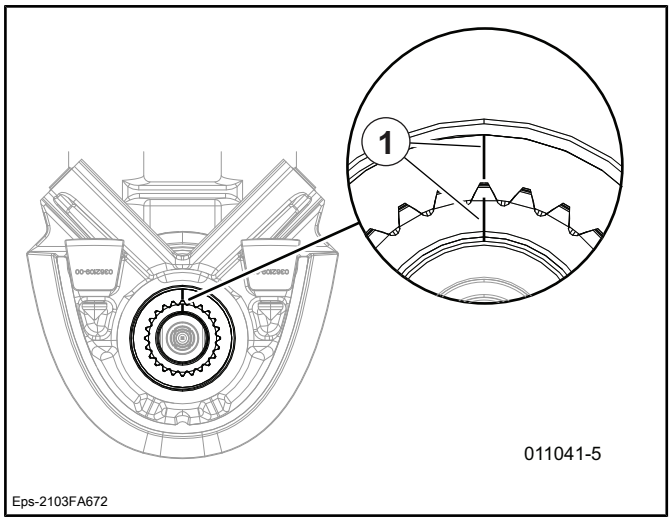
1. Plug

3. Use a pair of retaining ring pliers to remove the retaining ring from the shaft.

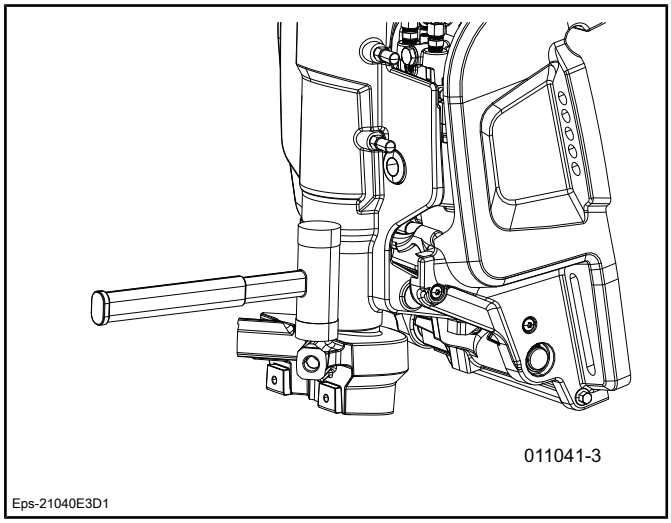


1. Retaining ring

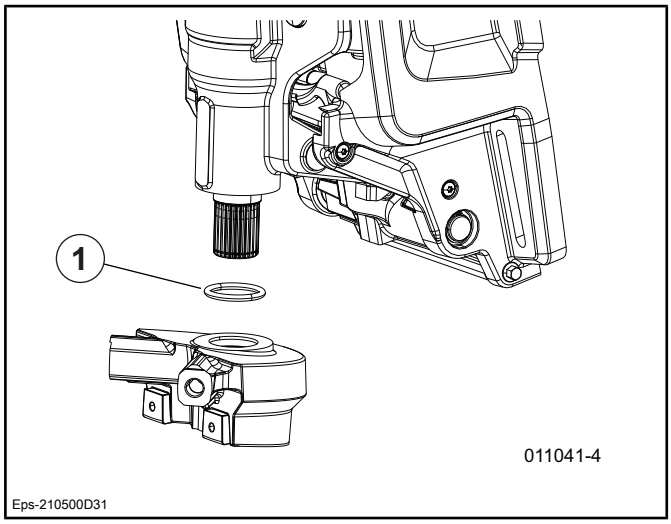
4. Make an alignment mark on the splined steering shaft and steering arm to aid re-assembly.



5. Use a soft face mallet to remove the steering arm from the steering shaft.



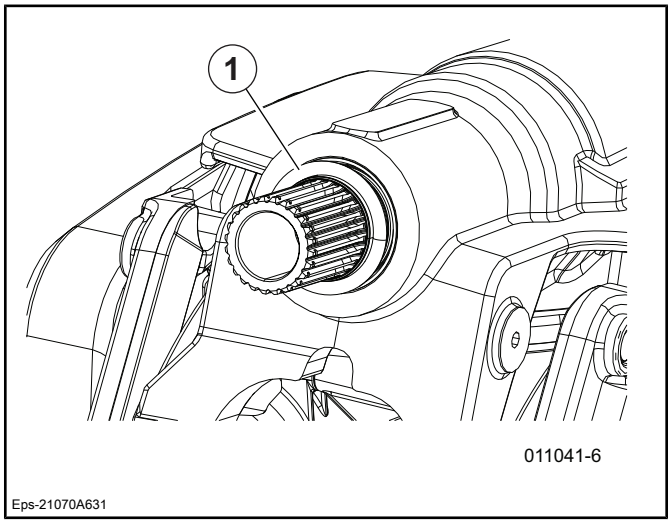
6. Remove the o-ring from the steering shaft.



1. O-ring

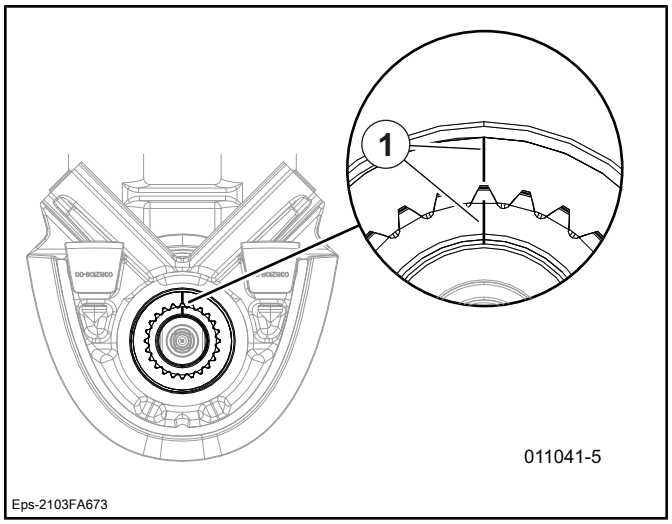
Lower Steering Arm Installation

1. Install a new o-ring on the steering shaft.



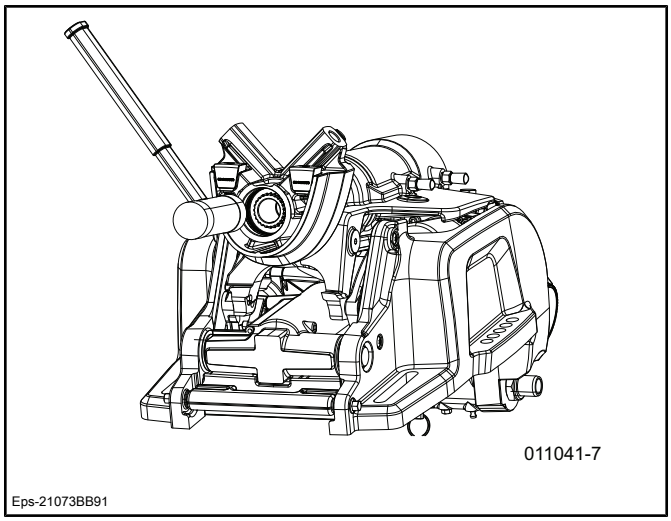
1. O-ring

2. Align the alignment marks of the steering arm and steering shaft then install the steering arm on the steering shaft.



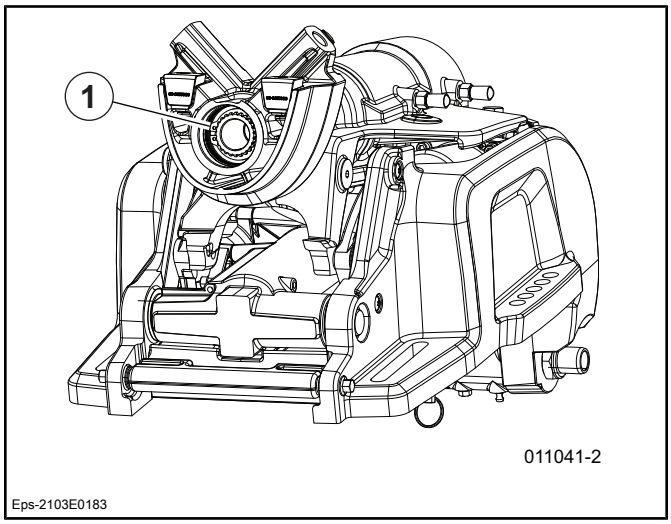
1. Alignment marks

3. If needed a soft-faced mallet may be used to seat the steering arm on the steering shaft.



4. Use a pair of retaining ring pliers to install the retaining ring.

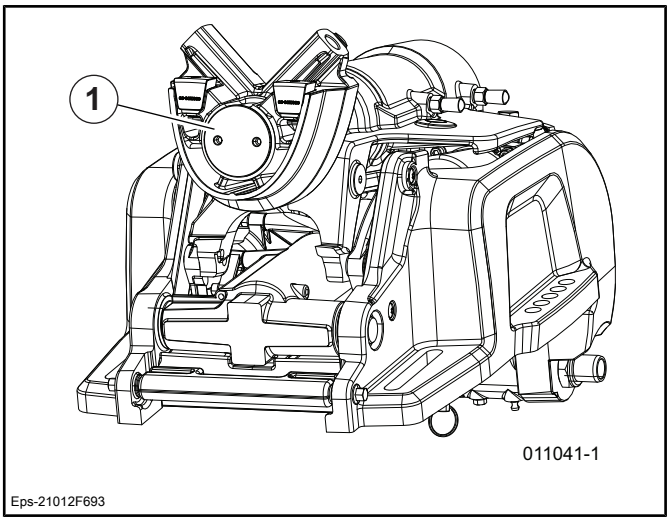
IMPORTANT: Make SURE the sharp edge of the retaining ring inner diameter is facing the plug.



1. Retaining ring

Required Tool
Spanner Wrench
P/N 912084

5. Use Spanner Wrench, P/N 912084, to install the plug. Tighten the plug to a torque of 60 to 84 in. lbs. (6.8 to 9.5 N·m).



1. Plug

6. Install the engine onto the stern and swivel bracket. Refer to **Stern and Swivel Bracket Installation**.

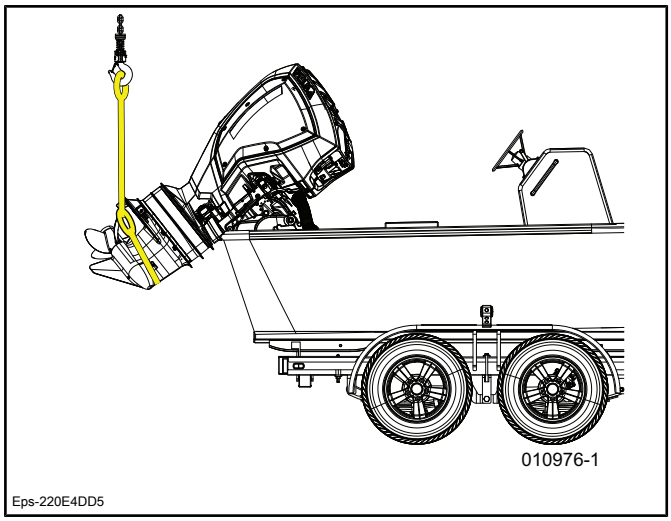
Trail Lock Lever Service

1. Tilt the outboard UP to access the trail lock lever.

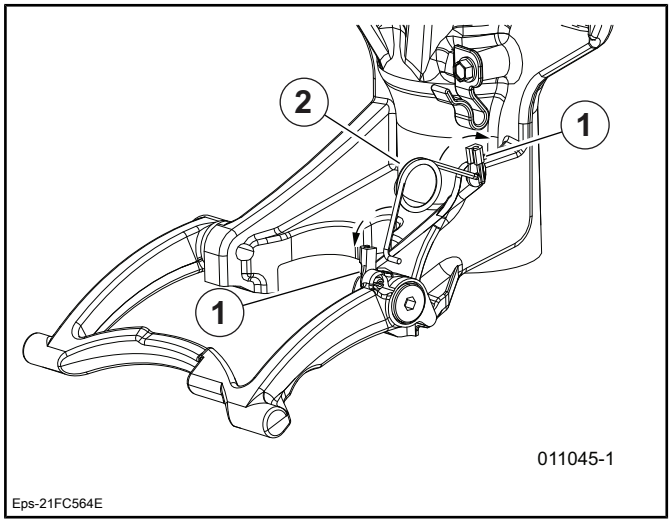
⚠ WARNING

Support the outboard by the gearcase in the UP position, with a suitable hoist.
When servicing the trim and tilt assembly, the outboard will drop from the tilted position. Avoid personal injury; always support the outboard's weight with a suitable hoist during service.

2. Use a strap and an appropriate hoist to support the outboard by the gearcase.

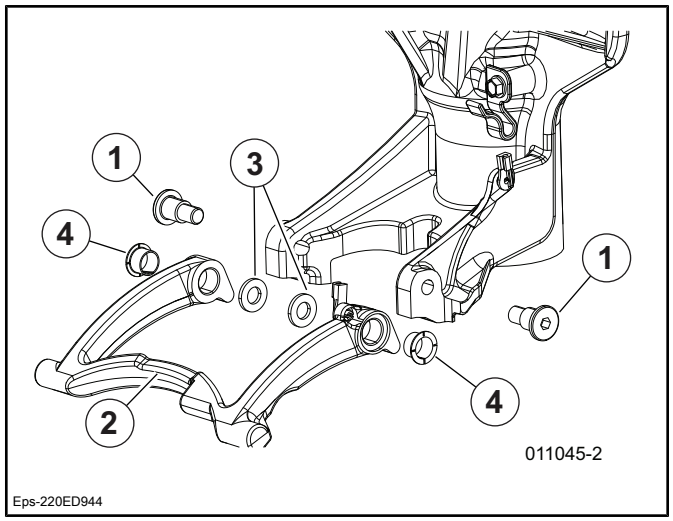


3. Release the retainers from the spring and remove the spring from the trail lock lever and swivel bracket.



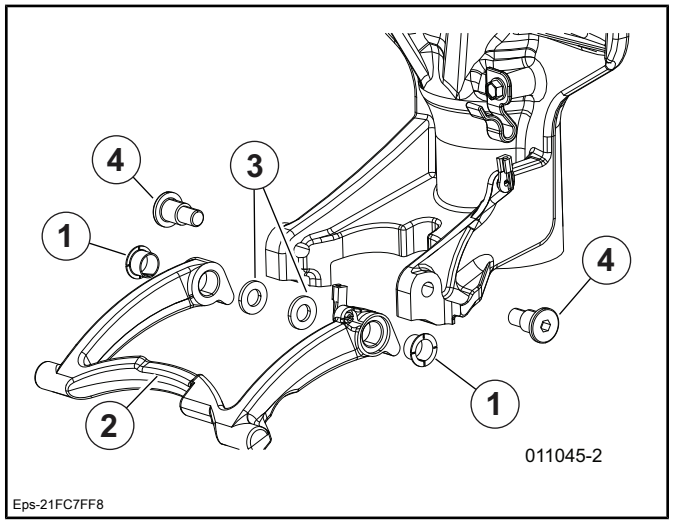
1. *Retainers*
2. *Spring*

4. Remove the two screws from the trail lock lever.
5. Remove the lever and two washers from the swivel bracket.
6. Remove the bushings from the trail lock lever.

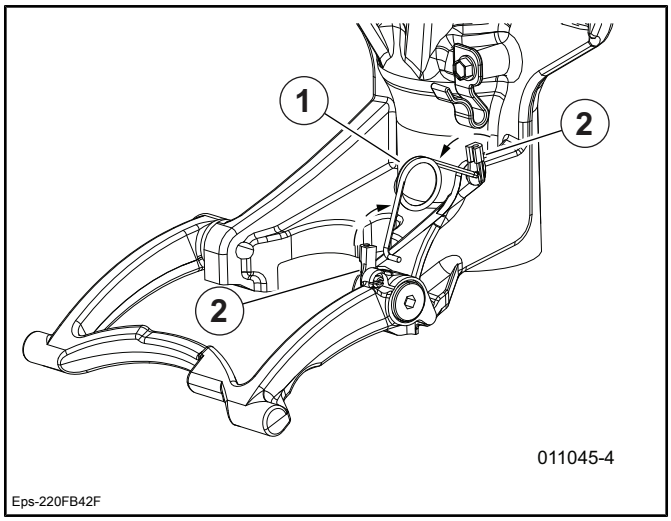


1. *Two Screws*
2. *Trail lock lover*
3. *Two washers*
4. *Bushings*

7. Apply *Triple Guard* grease to the two bushings and install them into the trail lock lever.
8. Install the lever and two washers onto the swivel bracket.
9. Install the two screws. Tighten screws to a torque of 18 to 20 Ft. lbs. (24 to 27 N·m).



10. Insert one end of the spring into one of the retainers. Rotate the retainer to lock onto the spring.
11. Insert the other end of the spring into the other retainer. Rotate the retainer to lock onto the spring.



1. Spring
2. Retainers

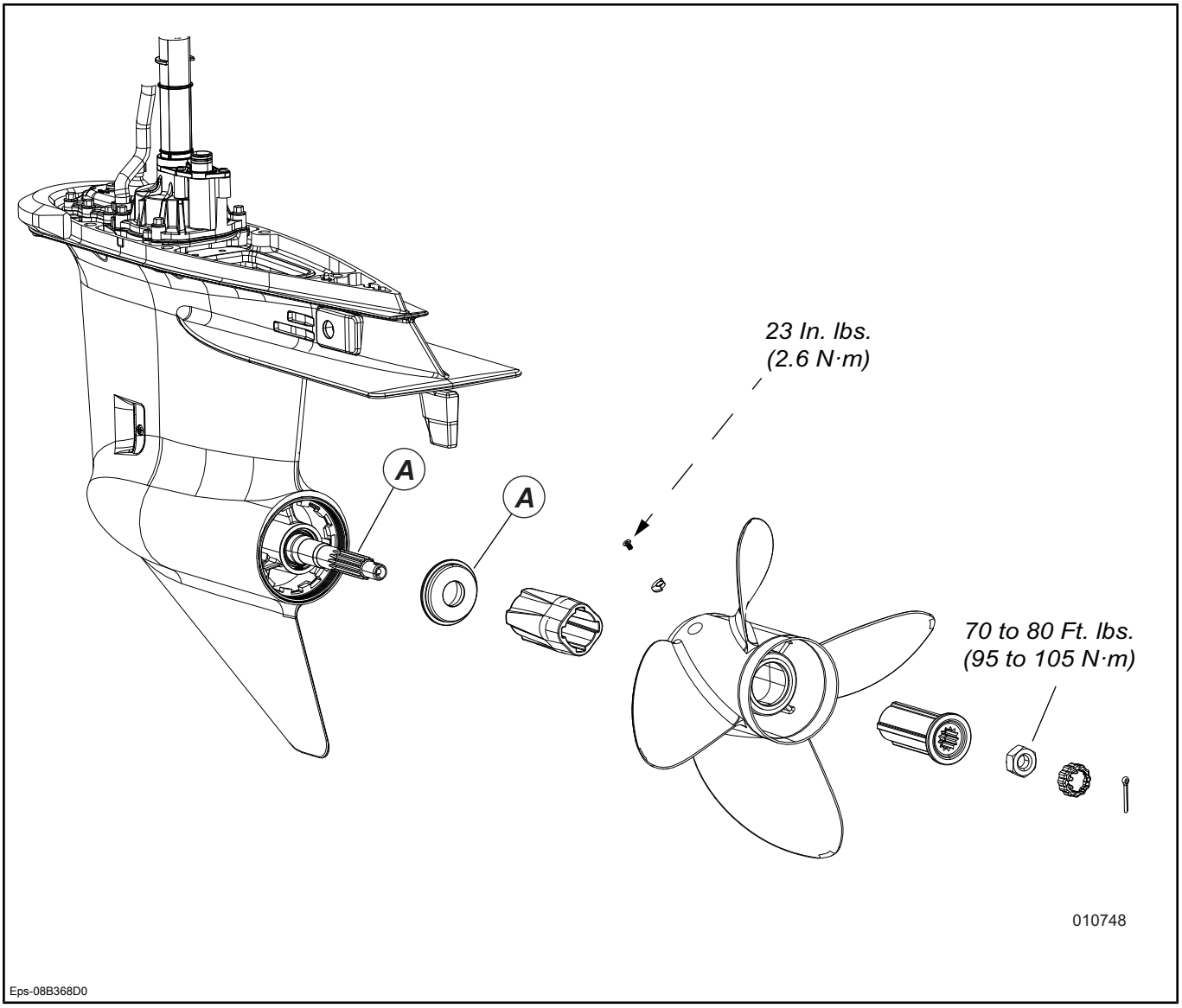
12. Remove the strap from the outboard and tilt the outboard down.

Gearcase

Service Chart: Propeller Hardware

Hardware shown is REQUIRED for use with RX3 and RX4 propellers.

Specified torque is for use ONLY with Propeller Hub Kit, P/N 5010529.



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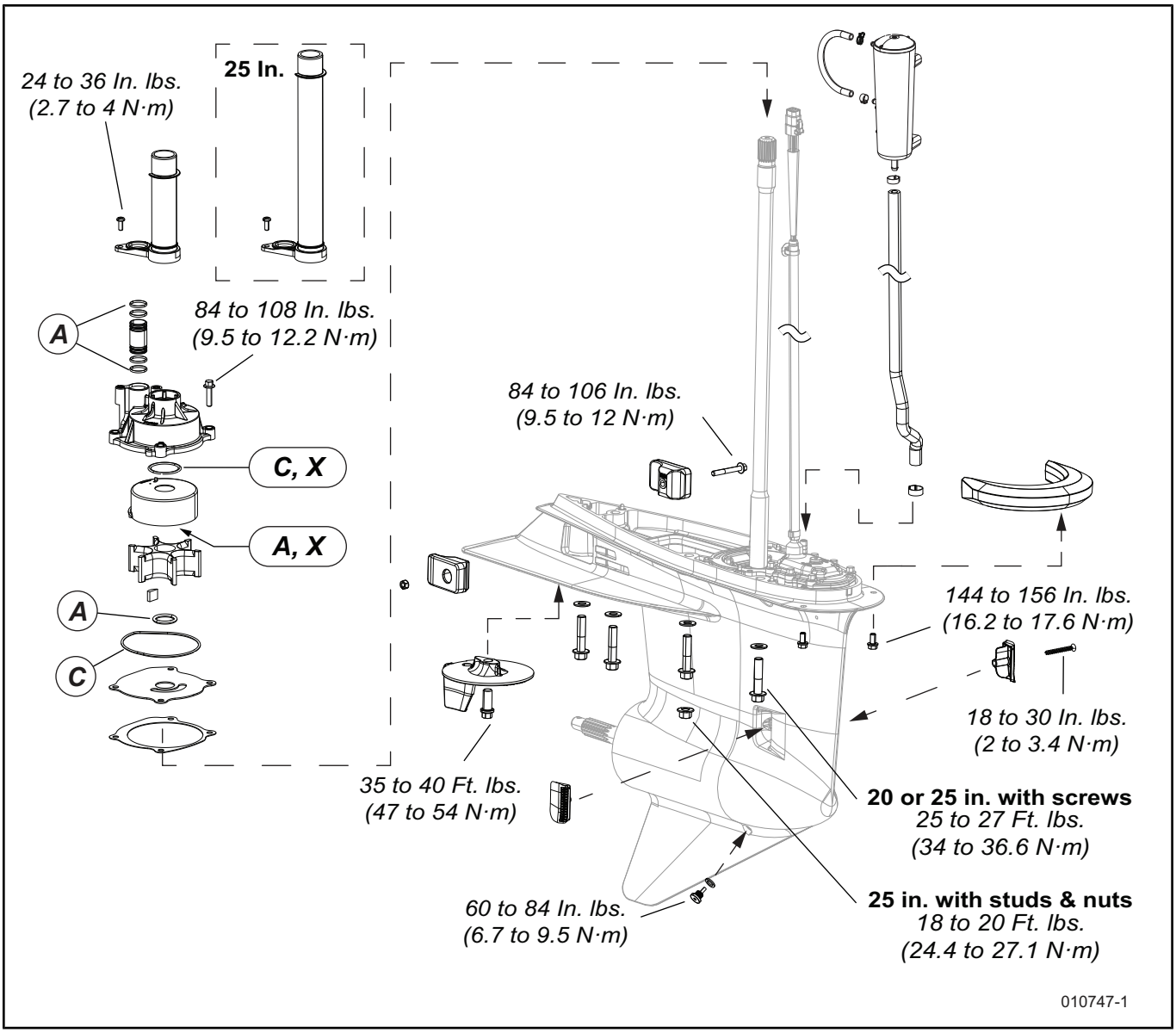
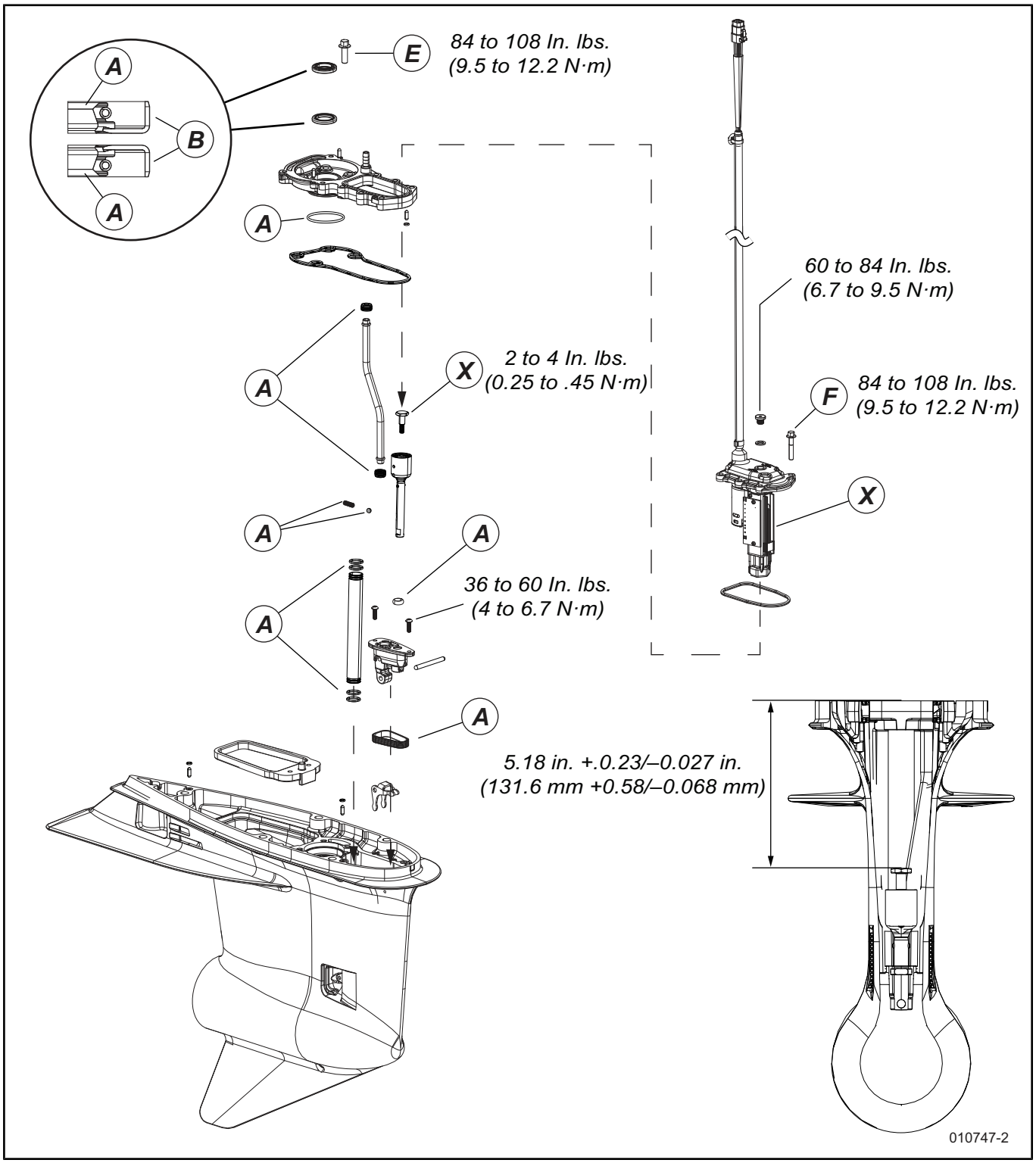
A	*Triple Guard* grease	***X***	See Service Manual procedure

Service Chart: Water Pump and Gearcase Housing



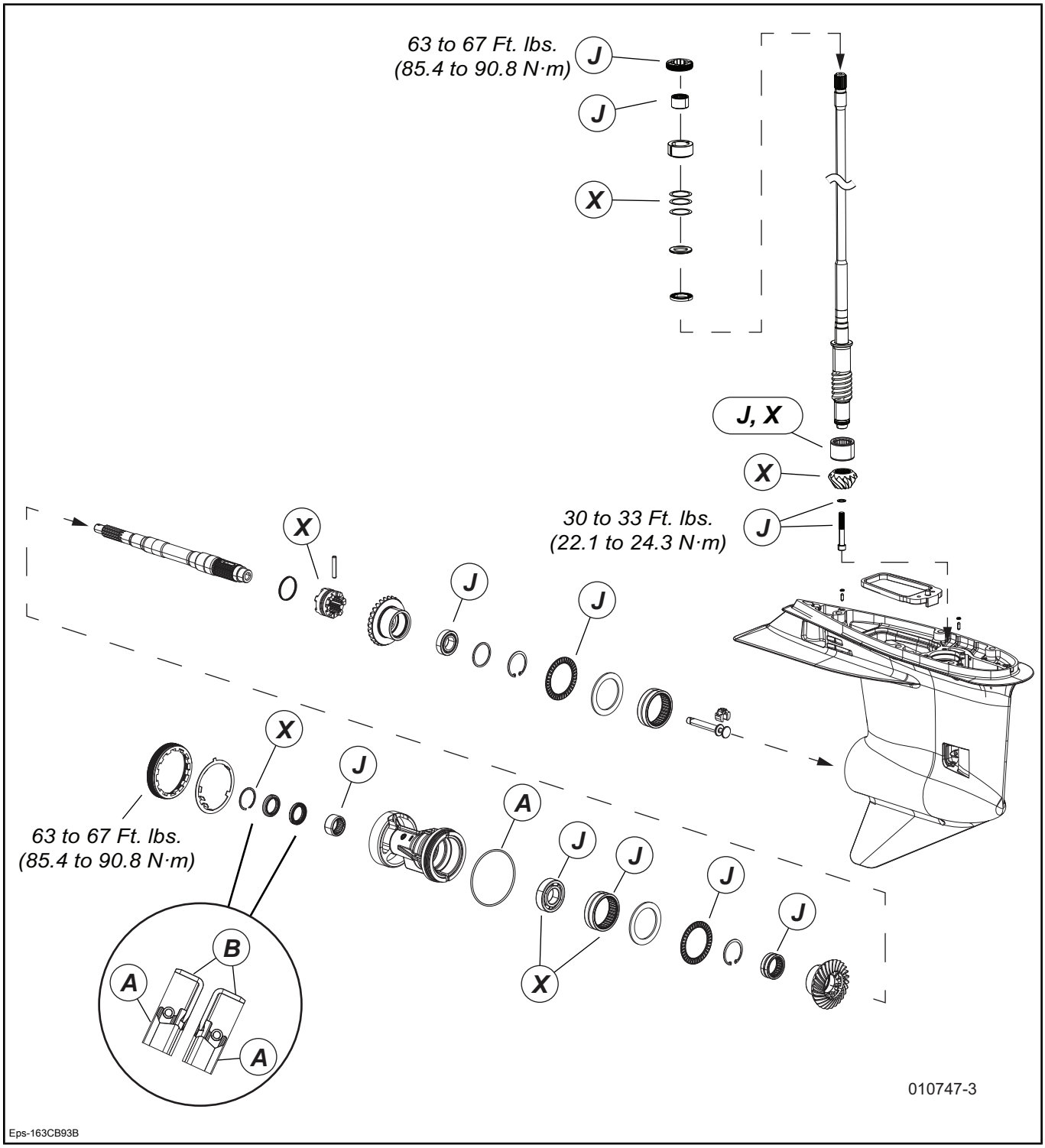
A	*Triple Guard* grease	***C***	Adhesive 847
D	Moly Lube	***X***	See Service Manual procedure

Service Chart: Manifold and Shift Actuator



A	*Triple Guard* grease	***B***	Gasket Sealing Compound
D	Moly Lube	***E***	Ultra Lock
F	Nut Lock	***X***	See Service Manual procedure

Service Chart: Driveshaft and Propeller Shaft

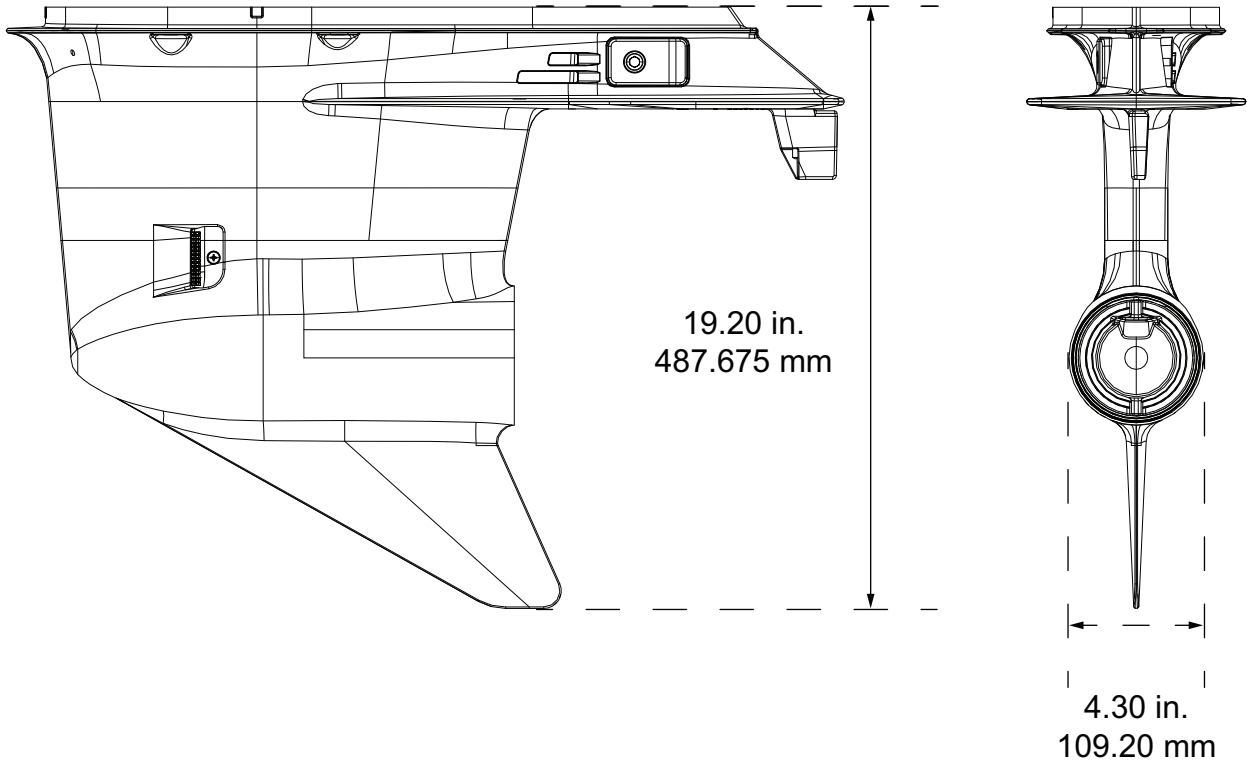


A	*Triple Guard* grease	***B***	Gasket Sealing Compound
J	Gearcase Lubricant (*HPF Pro*)	***X***	See Service Manual procedure

Gearcase Type

Outboard Model	Housing Type	Description of Features	Gear Ratio
Standard Rotation 20 in 25 in	**"SLX2"**	Straight leading edge, slip—fit propeller shaft bearing housing with retaining spanner nut and locking ring, heavy duty TRB gearset.	13:27, (0.48), 2.08:1
Counter Rotation 25 in			

Housing Profile



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Propeller Service

Inspection

⚠ WARNING

When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

Carefully examine propeller and outboard for the following:

- Damaged blades and signs of propeller cavitation (burned paint, etc.)
- Spun or overheated inner hub
- Worn or twisted splines and inadequate lubricant
- Damage to outer hub area
- Worn, missing, or incorrect thrust washer and spacer
- Correct size and style
- Check for bent or damaged propeller shaft and twisted splines.

Refer to **Propeller Hardware Installation**.

Propeller Selection

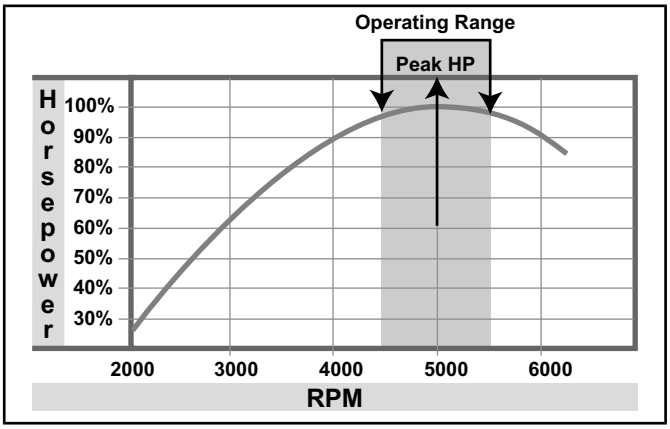
NOTICE

Selection of the wrong propeller could reduce engine service life, affect boat performance, or cause serious damage to the powerhead.
If the propeller blades have too much pitch, the engine will operate below the recommended full throttle operating range.
If the propeller blades have too little pitch, the engine will operate above the recommended full throttle operating range.

The RX3 and RX4 propellers are recommended specifically for *Evinrude E-TEC G2* Inline 3–cylinder outboards.

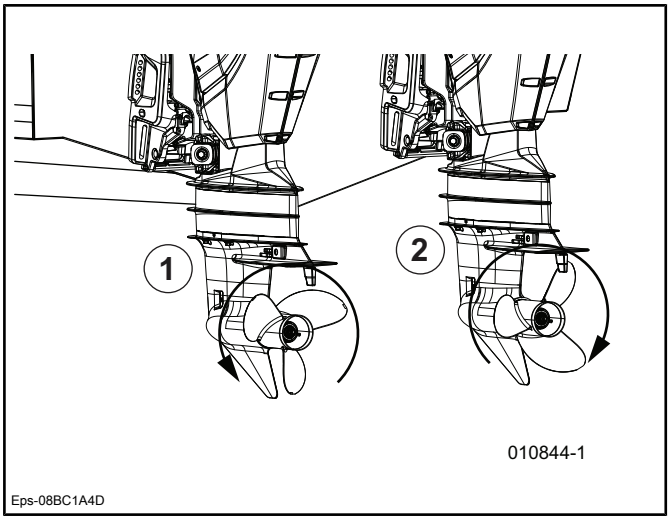
Water testing with various propeller designs and sizes is the best method of propeller selection.

The correct propeller, under normal load conditions, will allow the engine to run near the midpoint of the RPM operating range at full throttle. Refer to **Service Specifications**.



When selecting a propeller, consider the following:

- Use an accurate tachometer to determine the engine's full-throttle RPM.
- The outboard should be trimmed for top speed.
- Select a propeller that suits the customer's application and allows the engine to run near the midpoint of the full-throttle operating range when the boat has a normal load.
- Occasionally, one propeller will not cover a wide range of boat applications — water skiing to high speed performance boating. In such cases, it might be necessary to have a propeller for each situation.
- Refer to the *Evinrude/Johnson Genuine Parts and Accessories Catalog* for propeller styles and sizes.
- Right-hand propellers are considered standard rotation propellers. When propelling a boat forward, the propeller rotates in a right-hand (clockwise) direction as viewed from the rear.
- Left-hand propellers are considered counter-rotation propellers. When propelling a boat forward, the propeller rotates in a left-hand (counterclockwise) direction as viewed from the rear.



1. *Counter rotation*
2. *Standard rotation*

⚠ WARNING

For multiple outboard installations always check to be sure propellers are installed on the correct engines before aggressively operating the boat.

Propeller Hardware Installation

⚠ WARNING

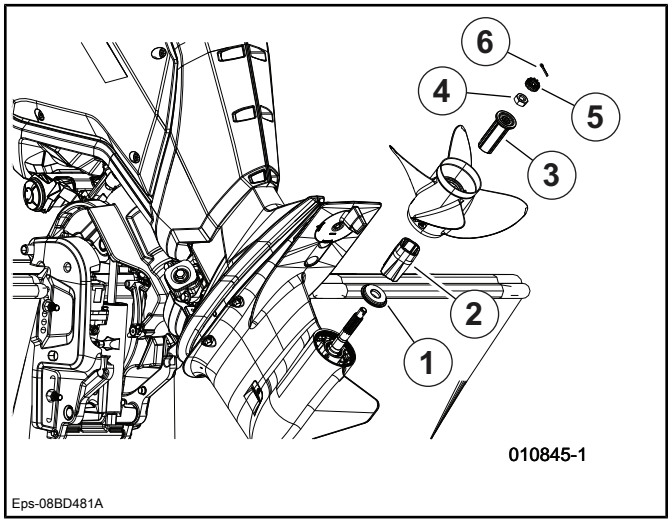
When servicing the propeller, always shift the outboard to NEUTRAL position, turn the key switch OFF and remove the key, so the outboard cannot be started accidentally.

IMPORTANT: *Evinrude E-TEC G2* Inline 3–cylinder outboards REQUIRE Propeller Hub Kit, P/N 5010529, and Nut & Keeper Assembly, P/N 5010505.

1. Apply *Triple Guard grease* to the splines of the propeller shaft before installing the propeller.

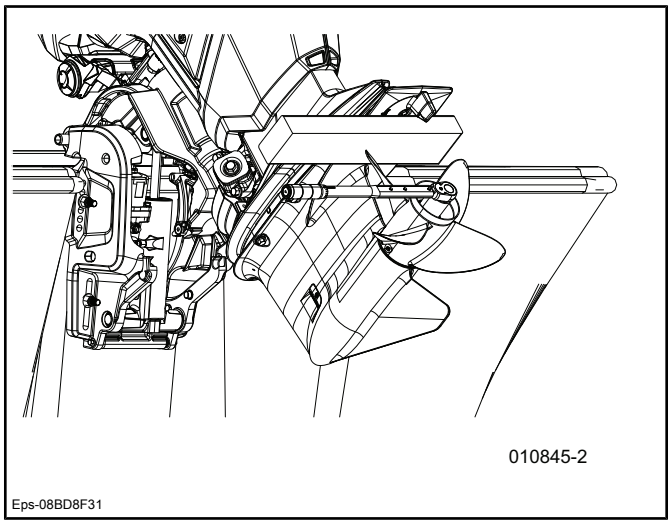
Required Chemical
Triple Guard Grease P/N 508298

2. Apply *Triple Guard* grease to to the thrust bushing, prop torsion bushing and sleeve and the entire propeller shaft before installing the propeller. This will ease assembly and disassembly as well as better protect components in salt water use
3. Install thrust bushing onto propeller shaft with taper of bushing matching taper of shaft. Then install the torsion bushing, and bushing and sleeve into the propeller.
4. Align splines of propeller and shaft. Push propeller until seated on the thrust bushing.
5. Install the propeller nut.



1. *Thrust bushing*
2. *Torsion bushing*
3. *Bushing and sleeve*
4. *Nut*
5. *Keeper*
6. *Cotter pin*

6. Wedge a block of wood between propeller blade and the anti-ventilation plate. Tighten the propeller nut to a torque of 70 to 80 ft. lbs. (95 to 109 N·m).



7. Install the keeper, then install a new cotter pin.

IMPORTANT: After installation, make sure outboard is in NEUTRAL and carefully spin the propeller. The propeller must turn freely without binding and should not spin off center. If the propeller binds, check for the correct thrust washer, P/N 128805, which is included with Propeller Hub Kit, P/N 5010529. If propeller appears to wobble, check for possible bent propeller shaft.

Gearcase Leak Test

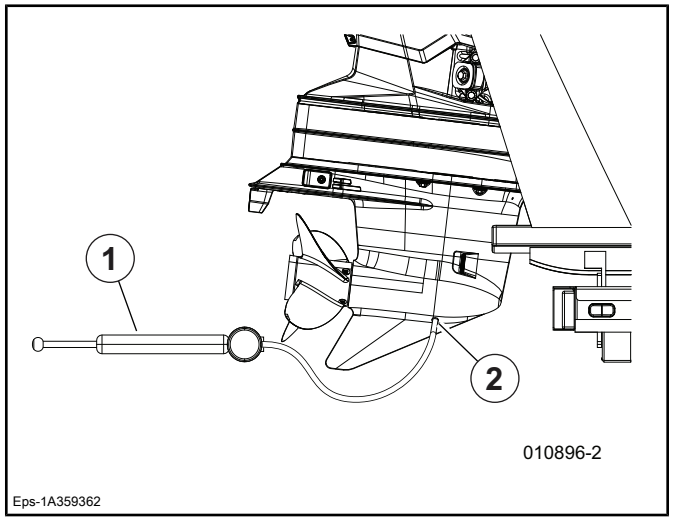
SERVICE TOOLS

Description	Part Number	Page
ALIGNMENT FIXTURE	P/N 360844	369, 374
BACKING PLATE	P/N 325867	344
BEARING HOUSING TOOL	P/N 358520	369
BEARING INSTALLER	P/N 360315	352, 374
BEARING INSTALLER	P/N 362024	349
COLLAR	P/N 362883	365
DRIVE HANDLE	P/N 311880	374
DRIVESHAFT PULLER	P/N 390706	344
DRIVESHAFT SHIMMING TOOL	P/N 5005925	365
EXTRA LARGE PULLER JAWS	P/N 360849	345, 350
GEARCASE PRESSURE TESTER	P/N 507977	321
GEARCASE VACUUM TESTER	P/N 507982	322
HANDLE	P/N 345822	378
LARGE PULLER JAWS	P/N 432129	349, 363
PINION BEARING REMOVER AND INSTALLER	P/N 5005927	368
PINION BEARING STAKING TOOL KIT	P/N 5010859	369
PROPELLER SHAFT ASSEMBLY INSTALLER	P/N 360847	378
PULLER BRIDGE	P/N 360312	350
PULLER BRIDGE	P/N 432127	347, 349, 363
PULLER JAWS	P/N 432131	347
PULLER PLATE	P/N 360314	350
PULLER PLATE	P/N 363152	345
PULLER SHAFT AND NUT	P/N 360313	345, 350
SEAL INSTALLER	P/N 330268	364
SEAL INSTALLER	P/N 362025	347
SEAL PROTECTOR	P/N 318674	382
SHIFT ROD INSTALLER/REMOVER	P/N 358162	380
SHIFT ROD INSTALLER	P/N 358162	332
SHIM GAUGE BAR	P/N 362882	365
SPANNER NUT SOCKET	P/N 360842	376
SPANNER NUT WRENCH	P/N 360054	340, 379
WIDE PULLER JAWS	P/N 391012	345, 350
WRENCH	P/N 360843	376

1. Remove the drain/fill screw and drain the lubricant before testing. Refer to **Gearcase Lubricant**.

Required Tool
Gearcase Pressure Tester **P/N 507977**

2. Install Gearcase Pressure Tester, P/N 507977, into the gearcase drain/fill.



1. Gearcase Pressure Tester, P/N 507977
2. Gearcase drain/fill

3. Install hose pinching pliers on the gearcase vent hose. Pressurize the gearcase to 3 to 6 psi (21 to 42 kPa).

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4. If pressure gauge indicates leakage, submerge the gearcase in water to determine source of leak.
5. If the gauge does not indicate leakage, increase pressure to 16 to 18 psi (110 to 124 kPa). Check for leaks.
6. Make necessary repairs and repeat test.

Required Tool
Gearcase Vacuum Tester **P/N 507982**

7. Install Gearcase Vacuum Tester, P/N 507982.
8. If previously removed, install hose pinching pliers on the gearcase vent hose. Apply 3 to 5 in. of vacuum (76 to 127 mm) Hg. with pump.
9. If vacuum gauge indicates leakage, apply oil around suspected seal. If leak stops or oil is drawn in, seal is defective.
10. Repeat test, gearcase must hold minimum of 15 in. vacuum (381 mm) Hg.

Gearcase Removal and Installation

SERVICE PRODUCTS

Description	Part Number	Page
ADHESIVE 847	P/N 776964	328
GASKET SEALING COMPOUND	P/N 508235	329–330, 347, 364
GEARCASE LUBRICANT (HPF PRO)	P/N 508298	356–357
GEARCASE LUBRICANT (HPF PRO)	P/N 778755	374, 376
LOCTITE 648 (OBTAIN LOCALLY)		375
MOLY LUBE	P/N 768306	325
NEEDLE BEARING GREASE	P/N 378642	375, 380
NEEDLE BEARING GREASE	P/N 508298	377
TRIPLE GUARD GREASE	P/N 508298	328
TRIPLE GUARD GREASE	P/N 508298	328–329, 347, 364, 377, 380–381
ULTRA LOCK (RED)	P/N 500422	382

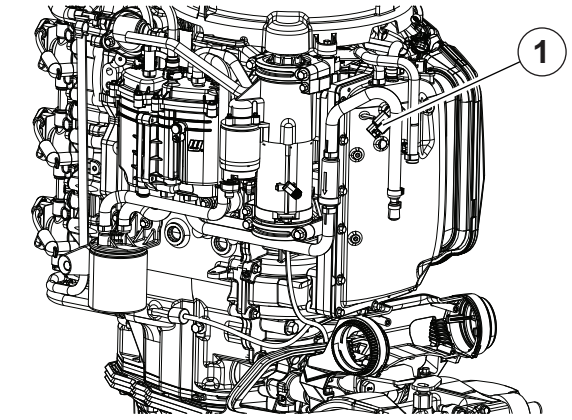
Gearcase Removal

⚠ WARNING

During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboards weight with a suitable hoist or the trailering lever during service.

IMPORTANT: Make sure the gearcase is shifted into NEUTRAL. The gearcase MUST be in NEUTRAL to remove the shift actuator.

1. Remove the starboard frame. Refer to **Engine Cover and Frame Service**.
2. Disconnect the shift actuator electrical connector from the engine harness. Make note of the actuator harness routing.



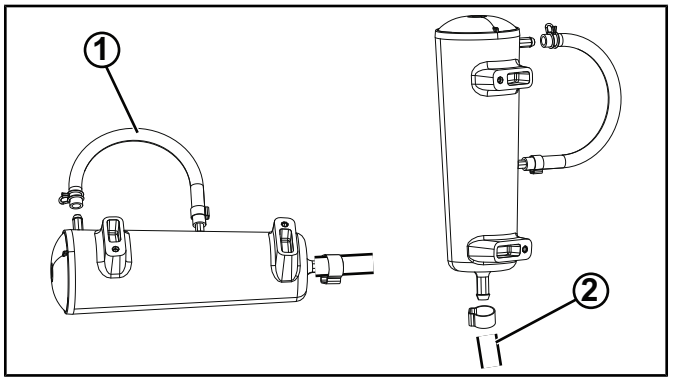
1. Shift actuator electrical connector

⚠ CAUTION

Gearcase lubricant may be under pressure and/or hot if outboard was recently operated or if gearcase lubricant is above the Maximum level.
Wear safety glasses and take precautions to avoid injury when removing vent hose from reservoir upper fitting.

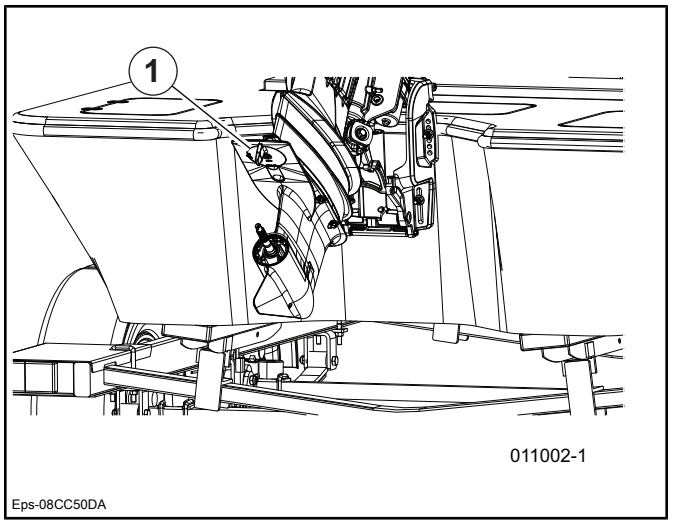
3. Turn the reservoir horizontal with the hose fittings facing upward as shown.
4. Remove the vent hose from the upper fitting to relieve gearcase pressure.
5. Remove the clamp from the gearcase oil reservoir hose.
6. Remove the hose from the gearcase oil reservoir. Make note of the oil hose routing.
7. Drain the oil into a suitable container.

8. Plug the end of the oil reservoir hose.



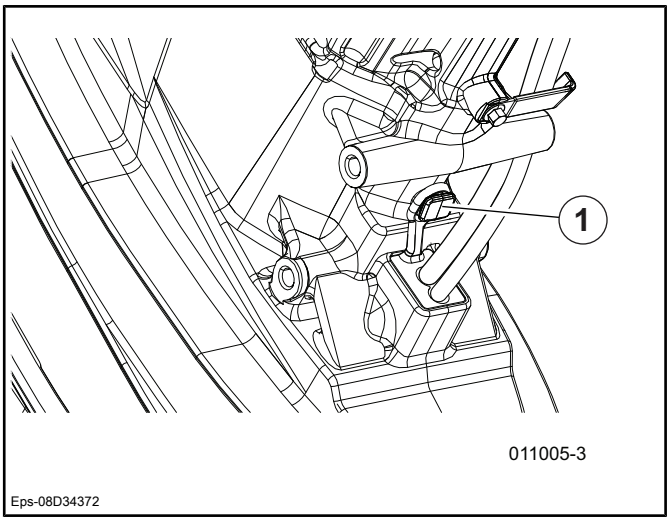
GEARCASE OIL RESERVOIR
1. *Remove the vent hose from the upper fitting*
2. *Remove hose from the gearcase oil reservoir*

9. Make note of the position of the trim tab. Then remove the trim tab from the gearcase.



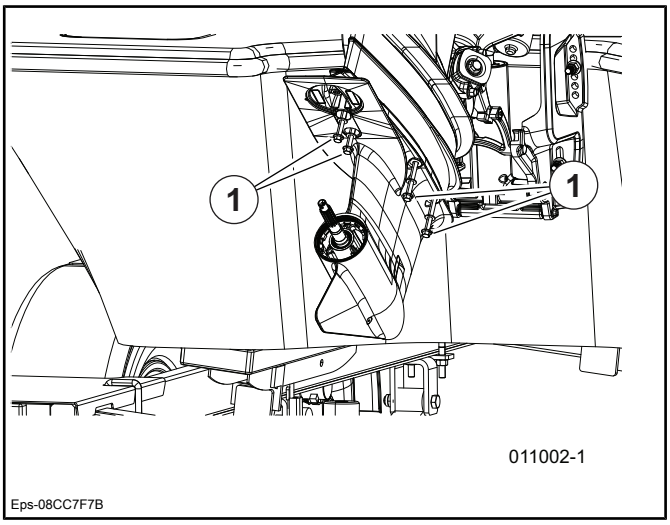
1. *Trim tab*

10. Remove the grommet retaining loop from the lug on the front of the gearcase. Push down on the grommet to loosen from the exhaust housing. The grommet is removed with the vent hose and actuator cable.



1. *Retaining loop and lug*

11. Remove the six screws retaining the gearcase and extension if a 25 inch model.



1. *Screws*

⚠ CAUTION

The extension assembly of 25 inch model outboards is NOT fastened to the exhaust housing. take precautions to avoid injury when removing the gearcase from a 25 inch model. The extension may come off with the gearcase, or could remain on the exhaust housing and fall unexpectedly after the gearcase is removed.

Gearcase Installation

⚠ WARNING

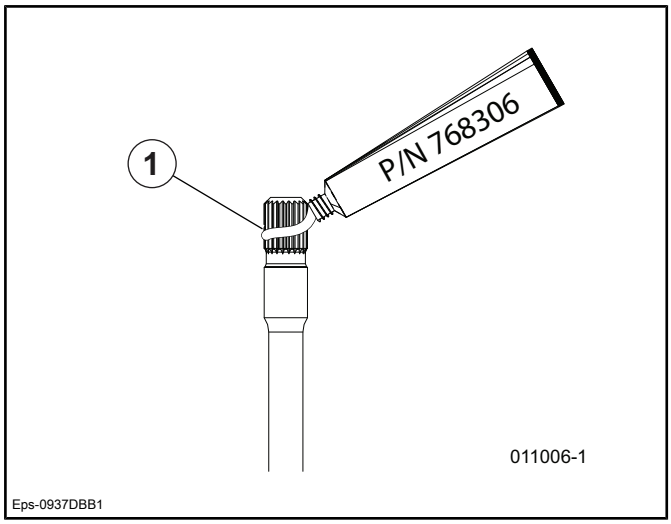
During service, the outboard may drop unexpectedly. Avoid personal injury; always support the outboards weight with a suitable hoist or the trailering lever during service.

NOTICE

Use *Evinrude Diagnostics* software (version 6.4 or later) to calibrate the shift actuator when installing a new gearcase or a new shift actuator. Failure to calibrate the shift actuator can result in damage to the shift actuator.

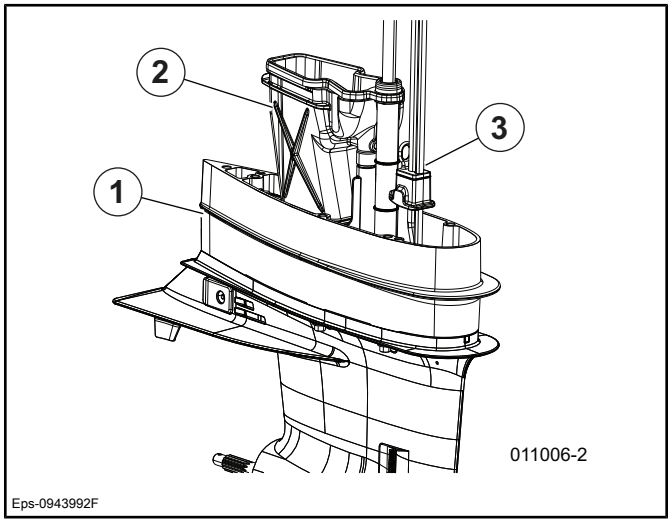
1. Coat the splines of the driveshaft with *Moly Lube*.

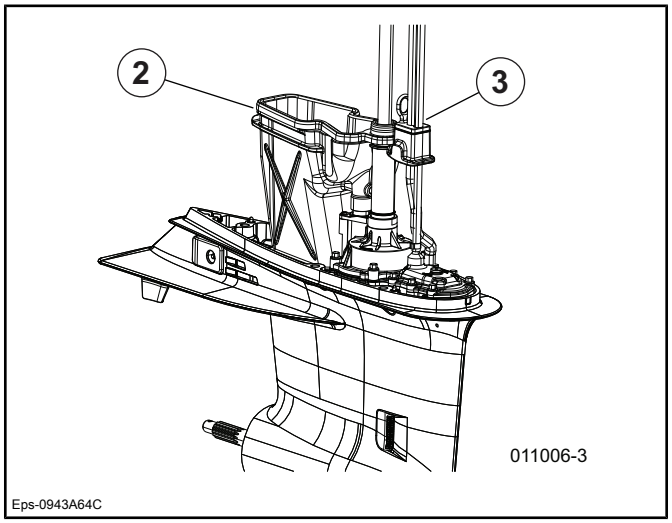
Required Chemical
Moly Lube P/N 768306



1. Splines

2. Shift the gearcase into FORWARD gear:
   1. Temporarily connect the shift actuator cable to the engine harness
   2. Turn the key switch to the ON position. Do NOT start the engine.
   3. Rotate the propeller shaft while a helper shifts the remote control into FORWARD gear.
3. After shifting the gearcase into FORWARD gear, turn the key switch to the OFF position.
4. Disconnect the shift actuator cable from the engine harness.
5. Install the extension on the gearcase (25 inch models only).
6. Install the lower exhaust adapter. Seals may be glued in place using Adhesive 847.
7. Spray soapy water on the grommet, oil vent hose and shift actuator cable.

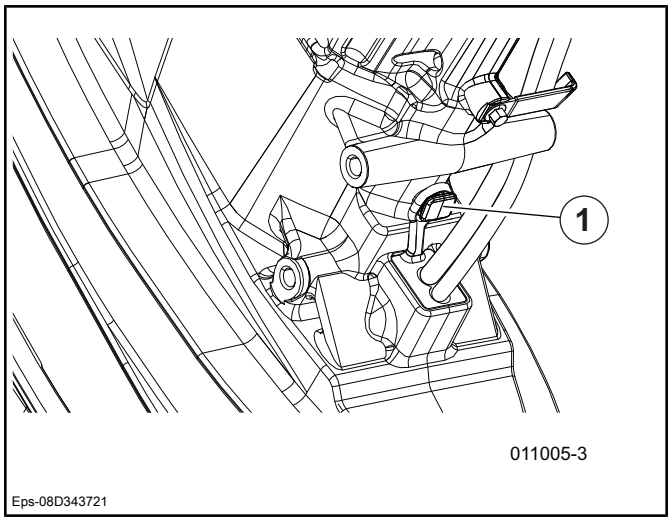




1. Extension (25 inch models)
2. Lower exhaust adapter
3. Grommet, hose and cable

The following steps will be easier to perform with a helper.

8. Route the oil hose and shift actuator cable through the opening at the front of the exhaust housing, pulling all slack through the opening.
9. Pull the grommet into the opening and secure the retaining loop to the retaining lug.



1. Retaining loop and lug

BEFORE continuing, make note of the two white alignment marks on the oil hose. The first is approximately 4.5 in. (115 mm) above the gearcase mounting flange, the second approximately 9.5 in. (241 mm) above the gearcase mounting flange.

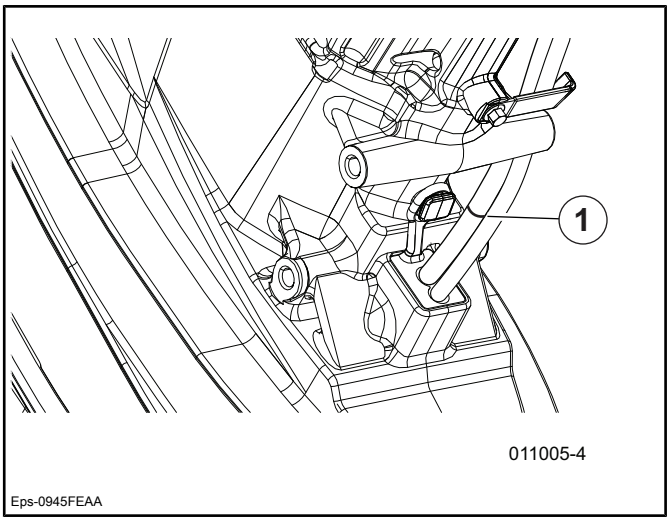
IMPORTANT: On a 20 inch model, the lower mark MUST be pulled through the grommet. On a 25 inch model, the upper mark MUST be pulled through the grommet. This is to ensure the vent hose is not kinked during gearcase installation.

10. Slide the gearcase into place, be sure:
    - Helper draws oil vent hose and shift actuator cable through grommet as gearcase is lifted into place. Spray additional soapy water as needed.
    - Driveshaft engages the crankshaft.
11. Install the gearcase as follows:

    20 inch models: use six washers and mounting screws. Tighten to a torque of 25 to 27 Ft. lbs. (34 to 36.6 N·m).

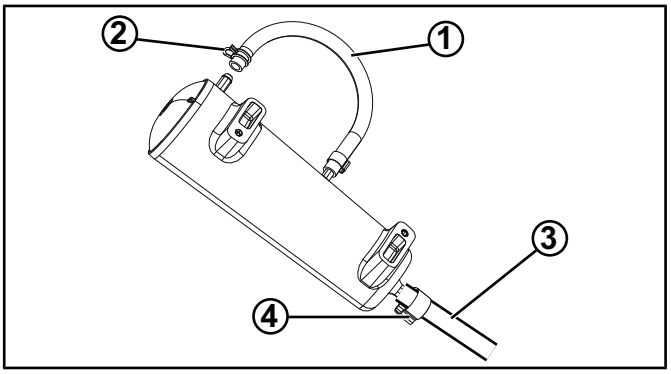
    Early 25 inch models: use six washers and mounting screws. Tighten to a torque of 25 to 27 Ft. lbs. (34 to 36.6 N·m).

    Late 25 inch models with studs: use six washers and nuts. Tighten to a torque of 18 to 20 Ft. lbs. (24.4 to 27.1 N·m).
12. Check oil vent hose. The white alignment make MUST be aligned with the top of the retaining lug as shown. This ensures the hose is not kinked and the gearcase is able to vent properly.



1. Alignment mark

13. Route the shift actuator cable to its original location and connect it to the engine harness.
14. Route the oil reservoir hose from the gearcase to the oil reservoir in its original location. Hose should have a direct continuous rise. Do NOT allow low points as low points may prevent the gearcase from venting properly.
15. Install the oil reservoir vent hose to the top of the oil reservoir, secure with spring clamp.
16. Install the oil hose on to the bottom of the oil reservoir with a new 15.7 mm *Oetiker* clamp.



1. Oil reservoir vent hose
2. Spring clamp
3. Oil hose
4. Oetiker clamp

17. Install the starboard frame. Refer to **Engine Cover and Frame Service**.

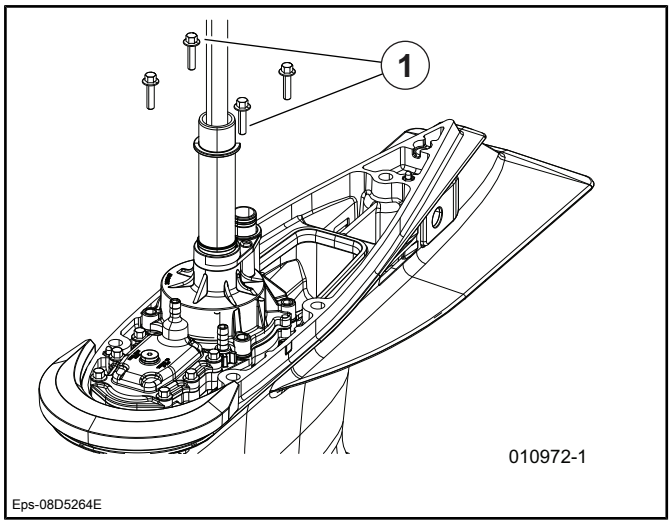
Water Pump Service

SERVICE PRODUCTS

Description	Part Number	Page
ADHESIVE 847	P/N 776964	328
GASKET SEALING COMPOUND	P/N 508235	329–330, 347, 364
GEARCASE LUBRICANT (HPF PRO)	P/N 508298	356–357
GEARCASE LUBRICANT (HPF PRO)	P/N 778755	374, 376
LOCTITE 648 (OBTAIN LOCALLY)		375
MOLY LUBE	P/N 768306	325
NEEDLE BEARING GREASE	P/N 378642	375, 380
NEEDLE BEARING GREASE	P/N 508298	377
TRIPLE GUARD GREASE	P/N 508298	328
TRIPLE GUARD GREASE	P/N 508298	328–329, 347, 364, 377, 380–381
ULTRA LOCK (RED)	P/N 500422	382

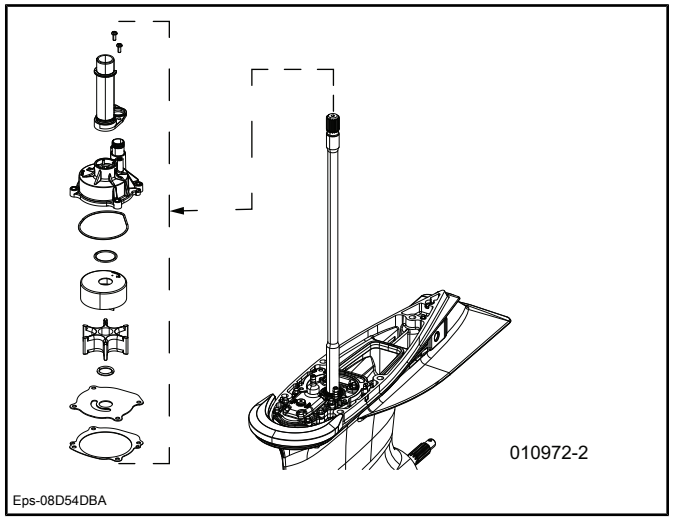
Disassembly

1. Remove the gearcase from the outboard. Refer to **Gearcase Removal and Installation**.
2. Remove the four impeller housing screws.



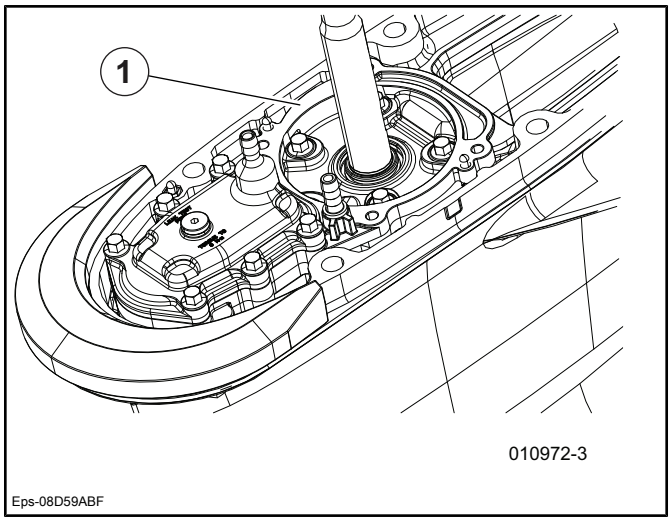
1. Four screws

3. Slide the water pump off the driveshaft.
4. Remove the impeller key, O-ring, impeller plate, and gasket. Discard the gasket.
5. Remove all the parts from the housing.



Inspection

1. Check impeller for overheating, hub separation, and other wear or damage.
2. Check liner and wear plate for scoring, distortion, and impeller material transfer.
3. Inspect the housing for cracks or melting.
4. Make sure gasket surface is clean and smooth.

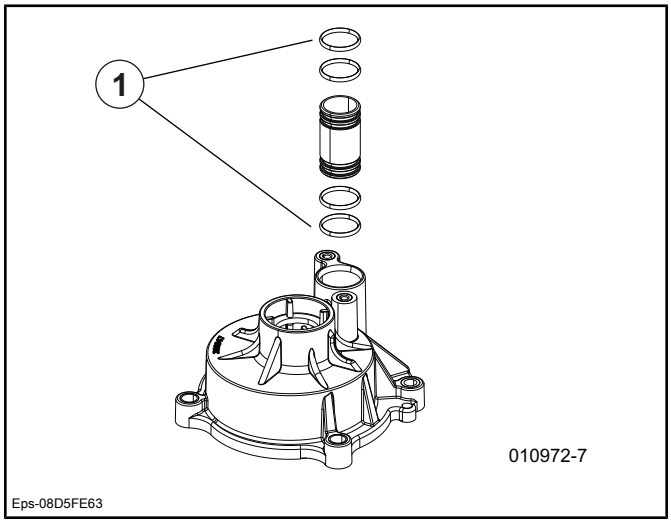


1. Gasket surface

Assembly

1. Lightly coat the four O-rings, P/N 346865, with *Triple Guard* grease. Install the O-rings on the water tube, P/N 360836 and install the tube into the housing.

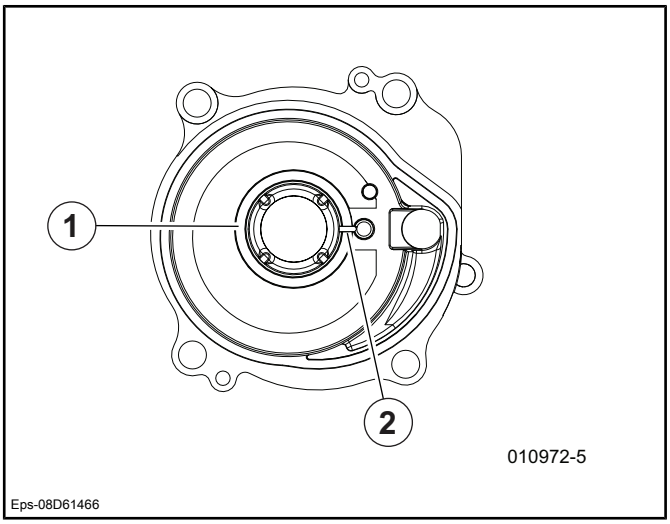
Required Chemical
Triple Guard grease
P/N 508298



2. Apply a drop of *Adhesive 847* into the O-ring groove.

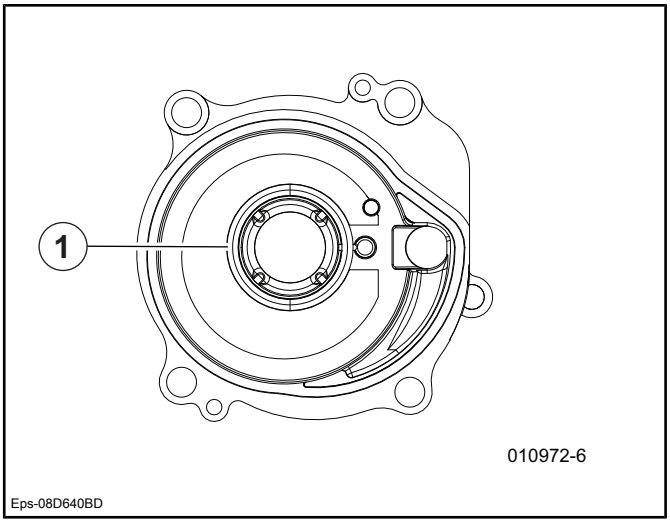
Required Chemical
Adhesive 847
P/N 776964

NOTE: Do not allow any sealer to get into the air bleed groove in the impeller housing. If this groove is blocked by adhesive, the pump will lose its prime and will not pump water.



1. O-ring groove
2. Air bleed groove

3. Install the O-ring in the impeller housing.

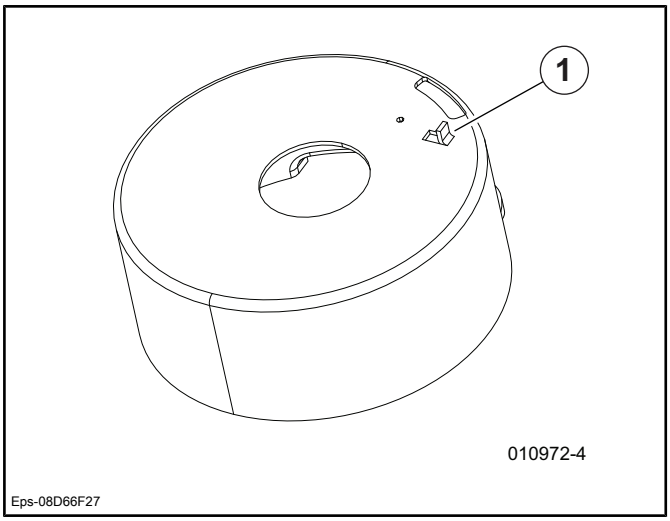


1. O-ring

4. Lightly coat the exterior rim of the impeller cup with *Triple Guard grease*.

Required Chemical
Triple Guard Grease
P/N 508298

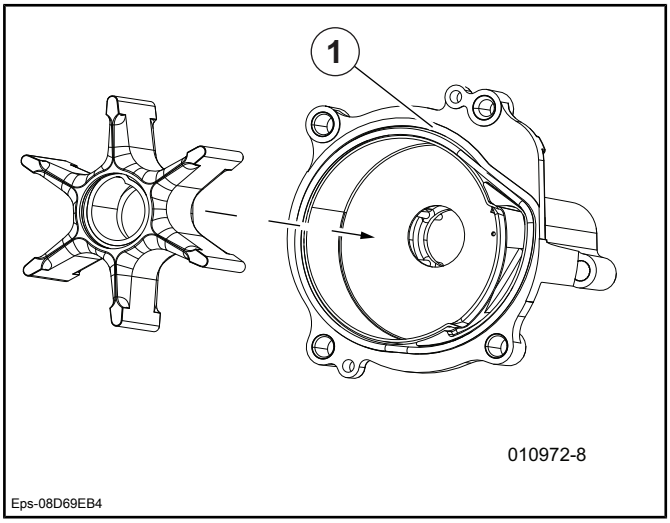
5. Install the cup in the impeller housing. The cup locks in place in the housing with a square index tab.



1. Index tab

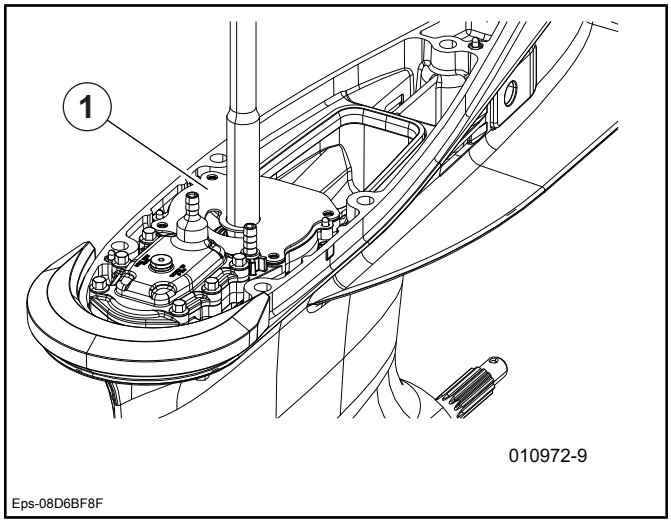
6. Lightly coat the of the vanes of the impeller with *Triple-Guard grease*.
7. With a counterclockwise rotation, install the impeller into the liner with the slot for the impeller key facing out.
8. Apply *Gasket Sealing Compound* to the housing seal and install it into the impeller housing.

Required Chemical
Gasket Sealing Compound
P/N 508235



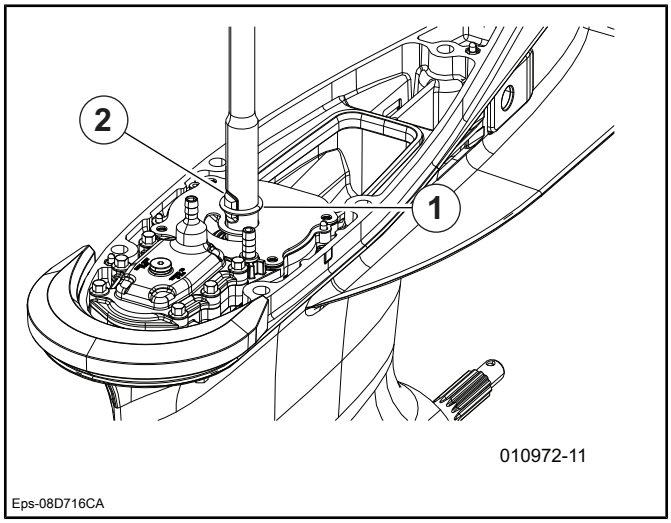
9. Apply *Gasket Sealing Compound* to both sides of a new impeller plate gasket.
10. Install the gasket and impeller plate.
11. Lightly coat the top side of the impeller plate with *Triple Guard grease*.

Required Chemical
Triple Guard Grease
P/N 508298



1. Impeller plate

12. Apply *Triple-Guard grease* to a new impeller O-ring.
13. Slide the O-ring down the driveshaft and half way over installed impeller key to temporarily hold key in place.



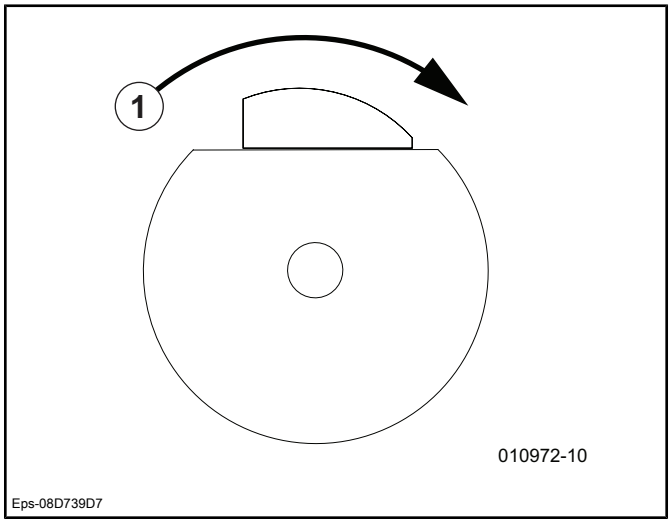
1. O-ring
2. Key

NOTE: The sharp edge of the key is the leading edge in clockwise rotation.

14. Slide the water pump down the driveshaft.
15. Align impeller slot with the impeller key.

16. Rotate the driveshaft to engage the key with the impeller, and slide water pump down over key.

NOTE: Be sure impeller key does not fall out of position.



1. Rotation

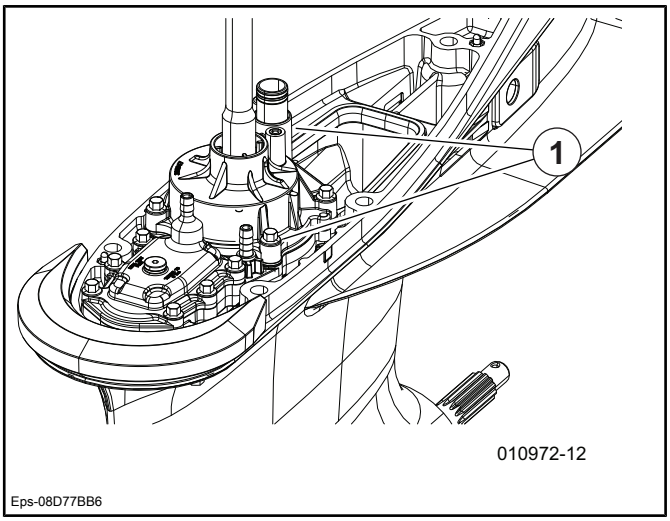
NOTICE

Make sure the impeller engages the impeller key. Serious powerhead damage will result if impeller key is not in place.

17. Align the impeller housing with the gearcase.

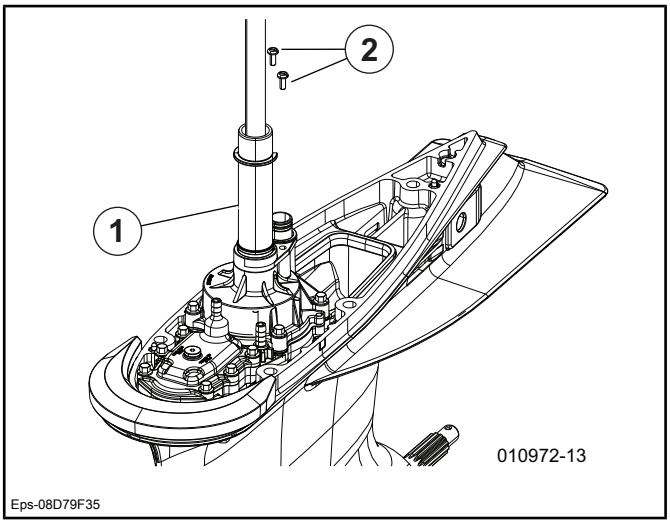
Required Chemical
Gasket Sealing Compound
P/N 508235

18. New screws have patch lock material and do NOT require thread locking compound. If re-using screws, apply *Gasket Sealing Compound* to threads of the four impeller housing screws.
19. Install the screws and tighten to a torque of 84 to 108 In. lbs. (9.5 to 12.2 N·m).



1. Four screws

20. Install the correct tube (20 or 25 inch) on the water pump housing. Install the two screws and tighten to a torque of 24 to 36 In. lbs. (2.7 to 4 N·m).



1. Two screws

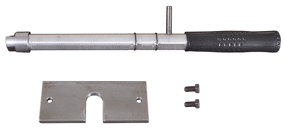
21. Install the gearcase. Refer to **Gearcase Removal and Installation**.

Shift Rod Adjustment

SERVICE TOOLS

Description	Part Number	Page
ALIGNMENT FIXTURE	P/N 360844	369, 374
BACKING PLATE	P/N 325867	344
BEARING HOUSING TOOL	P/N 358520	369
BEARING INSTALLER	P/N 360315	352, 374
BEARING INSTALLER	P/N 362024	349
COLLAR	P/N 362883	365
DRIVE HANDLE	P/N 311880	374
DRIVESHAFT PULLER	P/N 390706	344
DRIVESHAFT SHIMMING TOOL	P/N 5005925	365
EXTRA LARGE PULLER JAWS	P/N 360849	345, 350
GEARCASE PRESSURE TESTER	P/N 507977	321
GEARCASE VACUUM TESTER	P/N 507982	322
HANDLE	P/N 345822	378
LARGE PULLER JAWS	P/N 432129	349, 363
PINION BEARING REMOVER AND INSTALLER	P/N 5005927	368
PINION BEARING STAKING TOOL KIT	P/N 5010859	369
PROPELLER SHAFT ASSEMBLY INSTALLER	P/N 360847	378
PULLER BRIDGE	P/N 360312	350
PULLER BRIDGE	P/N 432127	347, 349, 363
PULLER JAWS	P/N 432131	347
PULLER PLATE	P/N 360314	350
PULLER PLATE	P/N 363152	345
PULLER SHAFT AND NUT	P/N 360313	345, 350
SEAL INSTALLER	P/N 330268	364
SEAL INSTALLER	P/N 362025	347
SEAL PROTECTOR	P/N 318674	382
SHIFT ROD INSTALLER/REMOVER	P/N 358162	380
SHIFT ROD INSTALLER	P/N 358162	332
SHIM GAUGE BAR	P/N 362882	365
SPANNER NUT SOCKET	P/N 360842	376
SPANNER NUT WRENCH	P/N 360054	340, 379
WIDE PULLER JAWS	P/N 391012	345, 350
WRENCH	P/N 360843	376

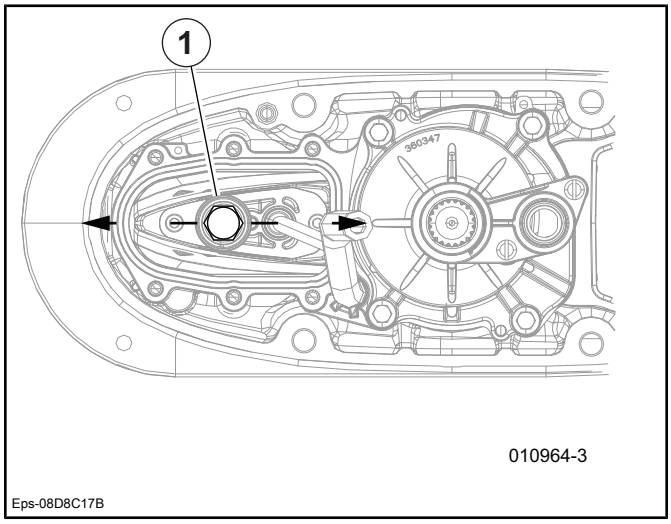
1. Use Shift Rod Installer, P/N 358162, to check shift rod height.

Required Tool	
Shift Rod Installer **P/N 358162**	

Required Tool
Shift Rod Installer **P/N 358162**

IMPORTANT: Tighten shift rod by hand, to a torque of 2 to 4 in. lbs. (0.25 to 0.45 N·m). Do **NOT** over-tighten. Over-tightening can damage the shifting mechanism, resulting in the inability to adjust or remove the shift rod.

2. Then loosen no more than 60° so the hex of the shift rod is oriented forward/aft.

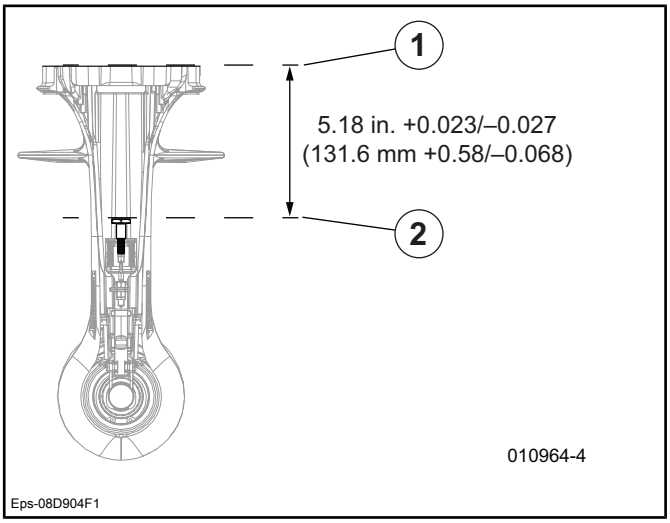


1. Hex of the shift rod oriented forward/aft

3. Install the tool onto the shift rod.

NOTE: Make sure the gearcase is in the NEUTRAL position. If needed, rotate the propeller shaft and use the tool to push or pull the shift rod to the NEUTRAL position.

4. Turn the handle of the tool clockwise to lower, or counterclockwise to raise the shift rod height.
5. Shift rod height is correct when dimension from the top surface of the gearcase housing to the top of the shift rod is 5.18 in. +0.023 / –0.027 (131.6 mm +0.58 / –0.068). Ensure the hex of the shift rod is oriented forward/aft. A misaligned hex will not accept the coupler of the shift actuator.



1. Top surface of gearcase housing
2. Top of shift rod

6. Turn the propeller shaft and pull the shift rod up until the clutch dog fully engages gear.

NOTE: The shift rod MUST be in the up position to install the shift actuator.

7. Remove the tool from the gearcase.

Shift Actuator

Control Circuit Tests

NOTICE

Use appropriate test leads or adapters such as Test Probe Kit, P/N 342677, when performing electrical tests. NEVER pierce the insulation of the engine wiring, or use any piercing-style test probe. Piercing insulation damages the wire and can cause other unintended electrical problems.

Leads from the test probe kit can be repaired, or custom test leads can be made locally if needed. Refer to **Eleectrical Testing**.

Circuit tests check the integrity of the main engine harness and *EMM* circuits using resistance or diode tests. Continuity tests check the integrity of ground circuits and/or the 55V circuit. These tests eliminate the need to disconnect the engine harness from the *EMM*, or remove the *EMM*.

Remove the electrical connector from the shift actuator.

Make sure the key switch is OFF.

Use the diode test function of a digital multimeter to check the shift actuator circuits. Use an appropriate test probe lead to connect the negative meter lead to the wire listed in the table, connect the positive meter lead to an engine ground.

need new pic

Shift Actuator Circuit Diode Test		
Wire	**Pin**	**Result**
Yellow/Blue	1	approximately 0.5 VDC
Yellow/Green	2	approximately 0.5 VDC
Red/White	3	0.11 to 0.125 VDC

Results:

- No reading (OL or ∞) indicates an open circuit.
- A reading of zero (0) indicates an short circuit.

Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Shift Actuator Ground Circuit

Use a digital multimeter with appropriate test probe leads to measure the ground circuit resistance. Connect the positive meter lead to the engine harness connector wire listed in the table. Connect the negative meter lead to engine ground.

Shift Actuator Ground Circuit Resistance		
Wire	**Pin**	**Result**
Black/White	5	< 1 Ω

Results:

An infinite reading (∞) indicates an open circuit. Isolate the faulty component. Check wiring and connections. Repair or replace faulty wiring.

Circuit Voltage Tests

⚠ WARNING

To prevent accidental starting of the outboard, disconnect the crankshaft position sensor (CPS).

Remove the propeller from the gearcase. Refer to .

Identify the shift actuator type Refer to . Make sure the shift actuator is connected to the engine harness.

Connect the negative (black) meter lead to engine ground. Use an appropriate test probe lead to connect the positive (red) meter lead to the wire listed in the table. Turn the meter ON and select DC volts.

Turn the key switch to the ON position. Do NOT start the engine.

Have an assistant rotate the propeller shaft while shifting the remote control to the shift position indicated in the table. Voltage should read as follows:.

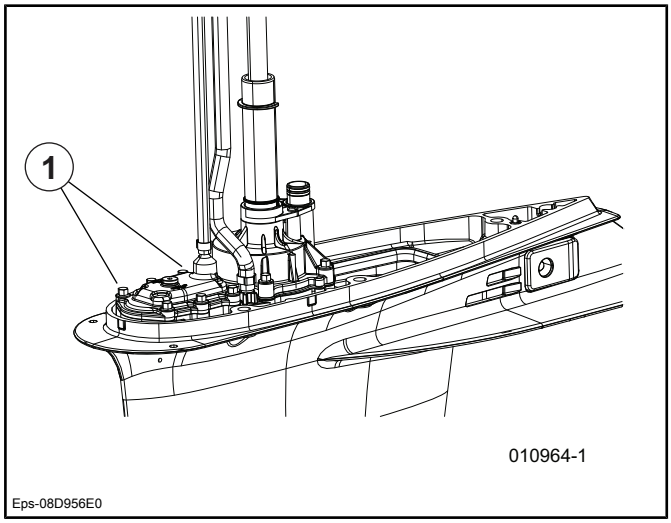
Circuit Voltage Tests			
Wire	**Pin**	**Shift Position**	**Results (VDC)**
Yellow/ Black	4	FORWARD	3.6 ± 0.3
		NEUTRAL	2.5 ± 0.2
		REVERSE	1.3 ± 0.2

Circuit Voltage Tests			
Wire	**Pin**	**Shift Position**	**Results (VDC)**
Yellow/ Red	6	FORWARD	1.2 ± 0.2
		NEUTRAL	2.6 ± 0.2
		REVERSE	6.6 ± 0.2

Shift Actuator Service

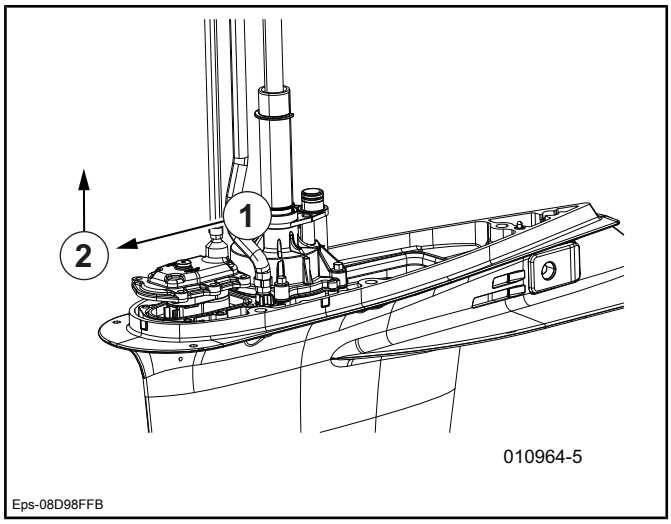
Shift Actuator Removal

1. Remove the gearcase, refer to **Gearcase Removal and Installation**.
2. Remove the six screws retaining the shift actuator to the gearcase housing.



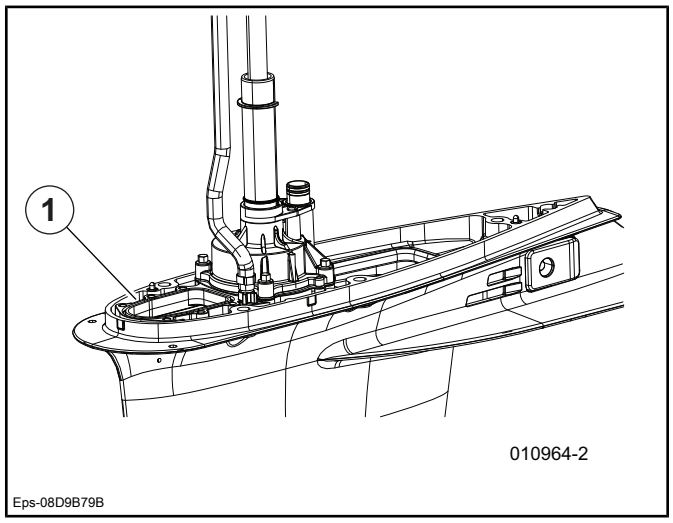
1. Six screws

3. Lightly tap the shift actuator with a soft mallet to loosen it.
4. Then lift and slide the shift actuator forward to remove.



1. Slide the shift actuator forward
2. Lift the shift actuator to remove

5. Remove the shift actuator seal and discard it.
6. Clean the mounting surface.



1. Seal

Shift Actuator Installation

NOTICE

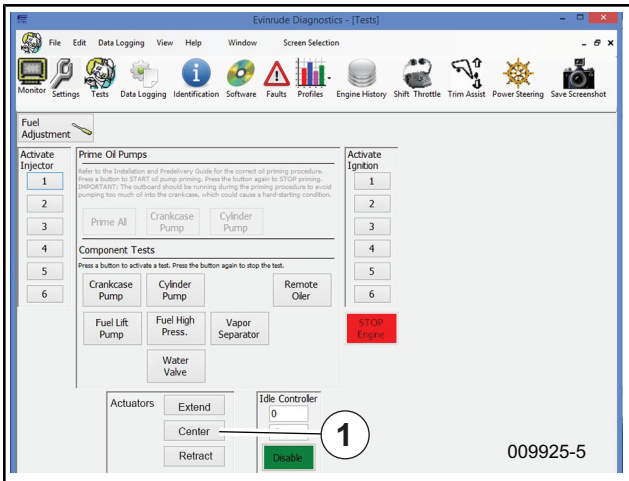
Check shift rod height BEFORE installing the shift actuator. Refer to Shift Rod Adjustment.

NOTICE

Use *Evinrude Diagnostics* software (version 6.4 or later) to calibrate the shift actuator when installing a new gearcase or a new shift actuator. Failure to calibrate the shift actuator can result in damage to the shift actuator.

IMPORTANT: The shift actuator MUST be centered in the NEUTRAL position.

1. Verify the shift actuator is centered.
2. Temporarily connect the shift actuator cable to the engine harness. Turn the key switch to the ON position. Do **NOT** start the engine.
3. Use the Tests feature of *Evinrude Diagnostics* software v 6.4 or higher. Under Actuators, select the Center button to center the shift actuator.



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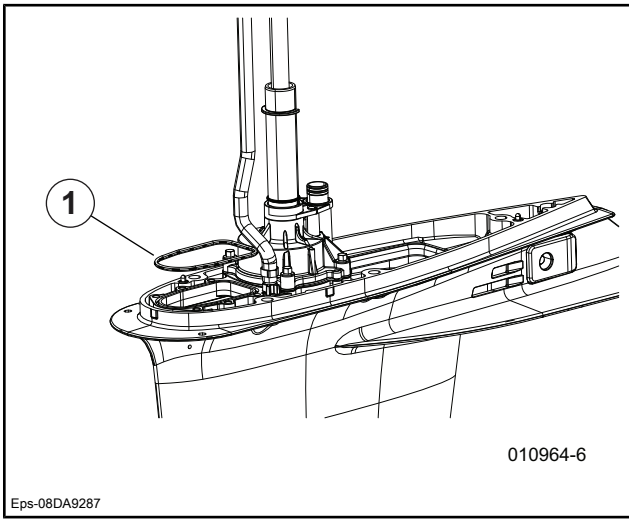
1. Shift actuator "Center" button

4. After verifying the shift actuator is centered, turn the key switch to the OFF position. Then disconnect the shift actuator cable from the engine harness.
5. Install the seal into the groove in the gearcase housing.



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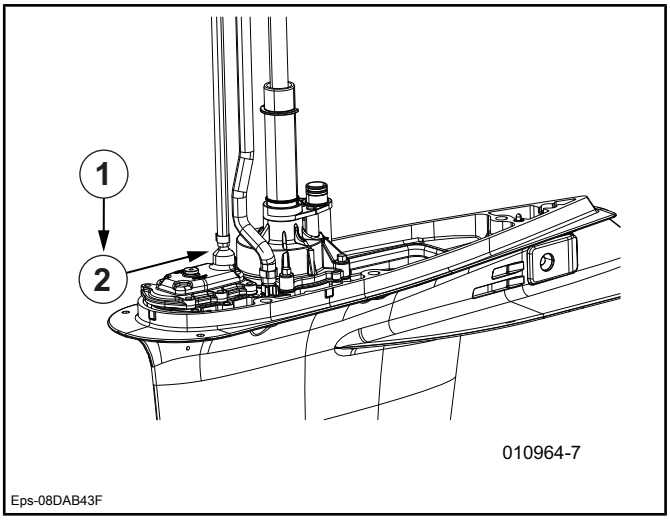
1. Seal

6. Confirm the shift rod is in the UP position. Lower the shift actuator into the gearcase cavity, then slide rearward so the coupler engages the shift rod.



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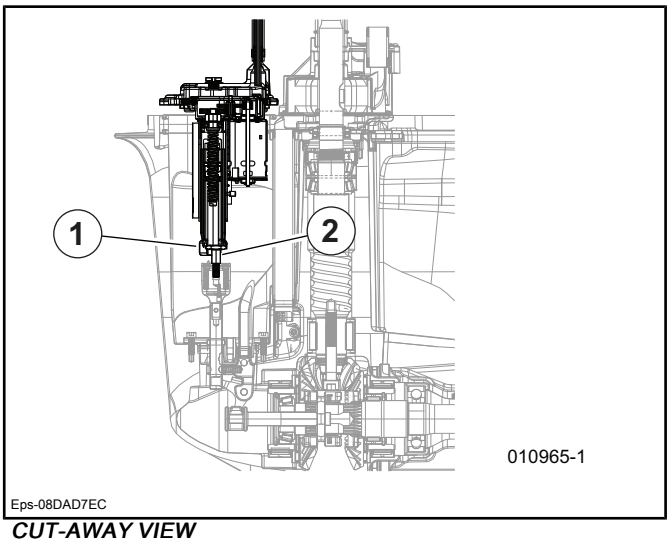
1. Lower the shift actuator into the gearcase cavity
2. Slide shift actuator rearward to capture the shift rod



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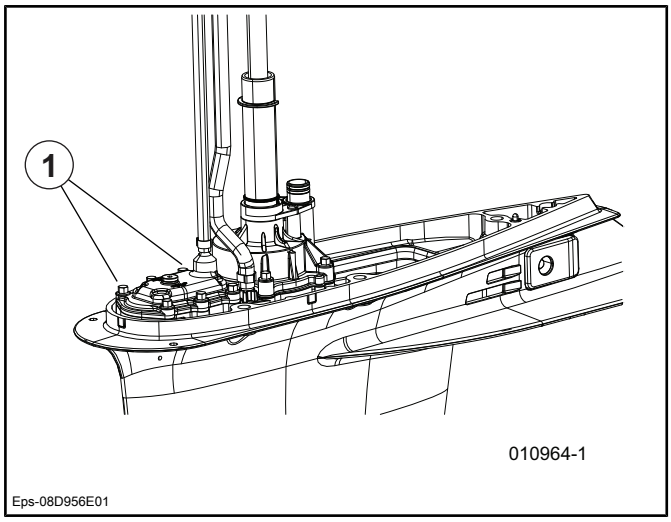
CUT-AWAY VIEW
1. Shift actuator coupler
2. Shift rod

IMPORTANT: Verify the shift actuator is connected to the lower shift rod by lifting the shift actuator.

7. Shift the gearcase into neutral. by rotating the propeller shaft while CAREFULLY pushing down on the shift actuator. Do NOT force the actuator.
8. Apply Nut Lock to the shift actuator retaining screws. Install the six screws and tighten to a torque of 84 to 106 in. lbs. (9.5 to 12 N·m).



1. Six screws

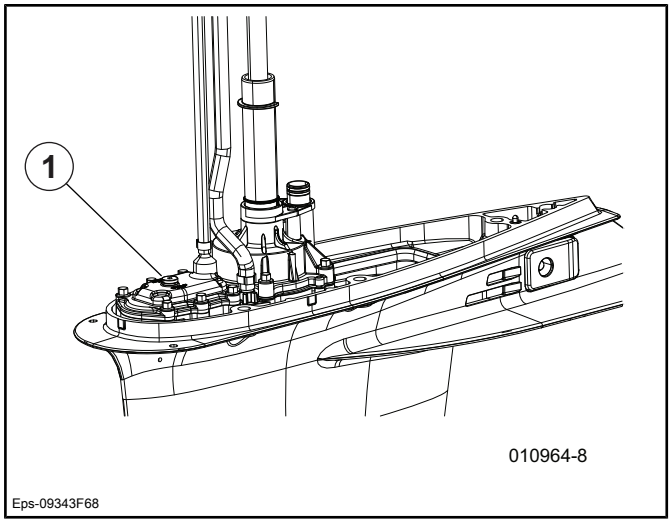
9. Leak test the shift actuator. Refer to **Shift Actuator Leak Test**.

Shift Actuator Leak Test

NOTICE

After completing the leak test, make SURE the seal is installed on the plug and the plug is tightened to the specified torque. Water intrusion into the shift actuator cavity will damage the shift actuator.

1. Remove the plug and seal from the top of the shift actuator.



1. Plug

IMPORTANT: This is an air cavity. Do NOT fill with oil.

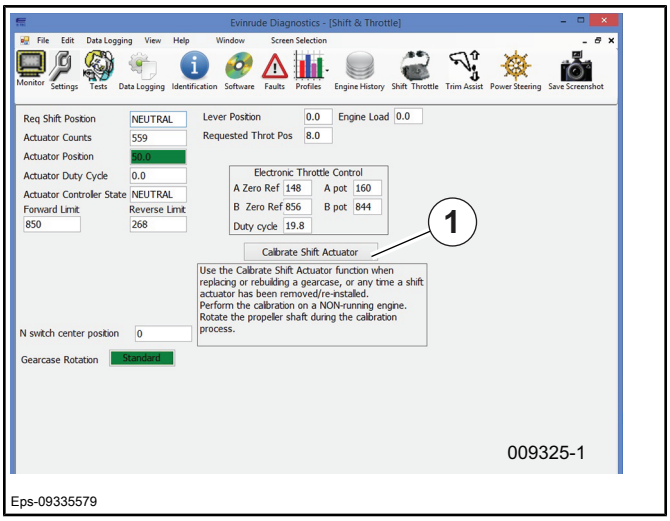
2. Temporarily connect the shift actuator electrical connector to the engine harness. Be aware that leakage can occur through the actuator harness and electrical connector. Connecting the actuator to the engine harness minimizes this effect.
3. Install Pressure Tester, P/N 507977, and pressurize to 16 to 18 PSI. (110 to 124 kPa).

   Pressure should not fall below 15 PSI (103 kPa) in less than 10 minutes. If the shift actuator does not hold pressure, check for and repair any leaks occurring on the gearcase.
4. After confirming there are no leaks, remove the pressure tester.
5. Install Vacuum Tester, P/N 507982, and apply 13 to 15 in. Hg. of vacuum (330 to 381 mm Hg). with pump.

   Vacuum should not fall below 10 in. Hg. (254 mm Hg) in less than 10 minutes. If the shift actuator does not hold vacuum, check for and repair any leaks occurring on the gearcase.
6. After confirming there are no leaks, remove the vacuum tester.
7. Reinstall the plug and seal in the top of the shift actuator. Tighten the plug to a torque of 60 to 84 in. lbs. (7 to 9.5 N·m).
8. Leave the shift actuator electrical connector connected to the engine harness and calibrate the shift actuator. Refer to **Shift Actuator Calibration**.

Shift Actuator Calibration

1. Use *Evinrude Diagnostic* software v 6.4 or higher to calibrate the shift actuator.
2. If the gearcase is removed from the outboard, temporarily connect the shift actuator cable to the engine harness.
3. Turn the key switch to the ON position. Do NOT start the engine.
4. Start the *Evinrude Diagnostic* software program. Then:
   - Select the *Shift Throttle* screen.
   - Rotate the propeller shaft until the calibration procedure is complete.
   - Select the *Calibrate Shift Actuator* button.



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1. Calibrate Shift Actuator button

5. When *Evinrude Diagnostics* software displays the *"Shift calibration was successfully completed"* message, turn the key switch to the OFF position.
6. After completing the calibration, turn the key switch to the OFF position.
7. The gearcase MUST be shifted into FORWARD gear before it is installed in order to align the drive shaft splines with the crank shaft splines.
    1. Turn the key switch to the ON position. Do NOT start the engine.
    2. Rotate the propeller shaft while a helper shifts the remote control into FORWARD gear.
    3. After shifting the gearcase into FORWARD gear, turn the key switch to the OFF position.
    4. Then disconnect the shift actuator cable from the engine harness.
8. Install the gearcase, refer to **Gearcase Removal and Installation**.

Gearcase Disassembly

SERVICE TOOLS

Description	Part Number	Page
ALIGNMENT FIXTURE	P/N 360844	369, 374
BACKING PLATE	P/N 325867	344
BEARING HOUSING TOOL	P/N 358520	369
BEARING INSTALLER	P/N 360315	352, 374
BEARING INSTALLER	P/N 362024	349
COLLAR	P/N 362883	365
DRIVE HANDLE	P/N 311880	374
DRIVESHAFT PULLER	P/N 390706	344
DRIVESHAFT SHIMMING TOOL	P/N 5005925	365
EXTRA LARGE PULLER JAWS	P/N 360849	345, 350
GEARCASE PRESSURE TESTER	P/N 507977	321
GEARCASE VACUUM TESTER	P/N 507982	322
HANDLE	P/N 345822	378
LARGE PULLER JAWS	P/N 432129	349, 363
PINION BEARING REMOVER AND INSTALLER	P/N 5005927	368
PINION BEARING STAKING TOOL KIT	P/N 5010859	369
PROPELLER SHAFT ASSEMBLY INSTALLER	P/N 360847	378
PULLER BRIDGE	P/N 360312	350
PULLER BRIDGE	P/N 432127	347, 349, 363
PULLER JAWS	P/N 432131	347
PULLER PLATE	P/N 360314	350
PULLER PLATE	P/N 363152	345
PULLER SHAFT AND NUT	P/N 360313	345, 350
SEAL INSTALLER	P/N 330268	364
SEAL INSTALLER	P/N 362025	347
SEAL PROTECTOR	P/N 318674	382
SHIFT ROD INSTALLER/REMOVER	P/N 358162	380
SHIFT ROD INSTALLER	P/N 358162	332
SHIM GAUGE BAR	P/N 362882	365
SPANNER NUT SOCKET	P/N 360842	376
SPANNER NUT WRENCH	P/N 360054	340, 379
WIDE PULLER JAWS	P/N 391012	345, 350
WRENCH	P/N 360843	376

SERVICE PRODUCTS

Description	Part Number	Page
ADHESIVE 847	P/N 776964	328
GASKET SEALING COMPOUND	P/N 508235	329–330, 347, 364
GEARCASE LUBRICANT (HPF PRO)	P/N 508298	356–357
GEARCASE LUBRICANT (HPF PRO)	P/N 778755	374, 376
LOCTITE 648 (OBTAIN LOCALLY)		375
MOLY LUBE	P/N 768306	325
NEEDLE BEARING GREASE	P/N 378642	375, 380
NEEDLE BEARING GREASE	P/N 508298	377
TRIPLE GUARD GREASE	P/N 508298	328
TRIPLE GUARD GREASE	P/N 508298	328–329, 347, 364, 377, 380–381
ULTRA LOCK (RED)	P/N 500422	382

Pre-Disassembly Inspection

⚠ WARNING

Wear safety glasses to avoid personal injury, and set compressed air pressure to less than 25 psi (172 kPa).

IMPORTANT: Clean and inspect all parts during disassembly. Replace any damaged parts, seals, O-rings, and gaskets.

Remove the propeller and mounting hardware.

Drain and inspect oil as described in **Gearcase Lubricant**.

Remove gearcase as described in **Gearcase Removal**.

Remove water pump as described in **Water Pump Service**.

Remove the shift actuator as described in **Shift Actuator Removal**.

Before disassembling the gearcase, examine the following:

- **Gearcase Housing —** Check for visible damage to skeg, strut, anti-ventilation plate, bullet, and mating surface. Check seal areas for visible signs of lubricant leakage.
- **Propeller Shaft —** Check for bent or damaged shaft. Check for twisted splines and damaged threads.
- **Shift Actuator —** Check for water or oil in the shift actuator cavity.
- **Gearcase Anodes —** If anodes have eroded to two-thirds their original size, they must be replaced.
- **Drive Shaft —** Check splines for visible damage, twisting and wear. Severe spline wear indicates the exhaust housing or gearcase has been distorted, possibly by impact damage.
- **Water Intake Screens —** Check for damage and blockage. If screens cannot be cleaned, they must be replaced. Refer to the correct parts catalog.
- **Fasteners —** Check all fasteners for wear or damage. Use new fasteners when specified. If reusing fasteners clean all old thread locking compound from the threads. Apply thread locking compound or lubricant as specified.

Propeller Shaft Bearing Housing, Propeller Shaft and Gear Removal

The propeller shaft bearing housing of SLX2-Type gearcase is slip-fit into the gearcase housing.

1. Use a punch to bend the tab of the locking ring down.

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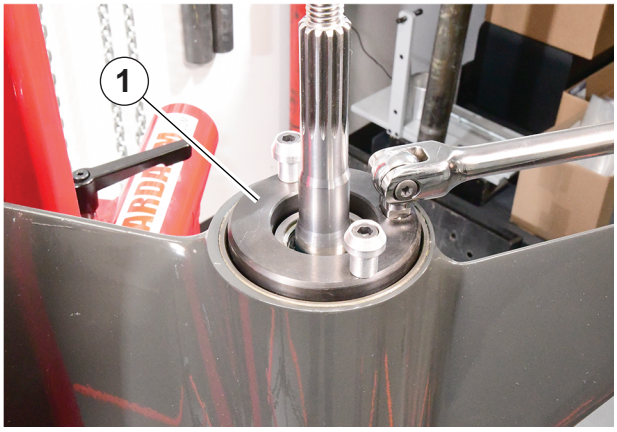
1. Bend tab of locking ring down

Required Tool
Spanner Nut Wrench
P/N 360054

2. Use Spanner Nut Wrench, P/N 360054, with a breaker bar to loosen the spanner nut. Turn the nut counter-clockwise to loosen.



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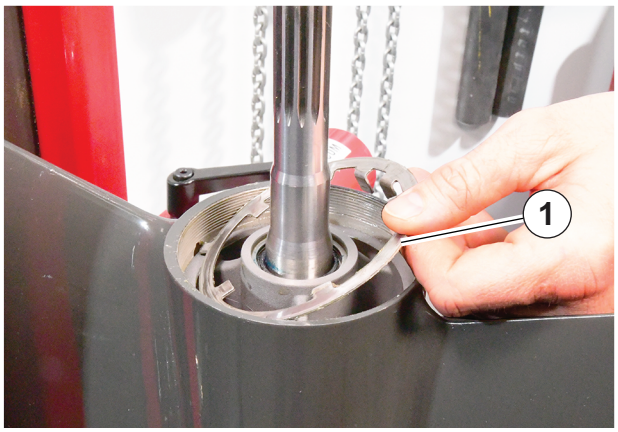
1. Spanner Nut Wrench, P/N 360054

3. Once the spanner nut is loose, use the wrench to remove the spanner nut by hand.
4. Remove the lock ring from the gearcase.



1. *Lock ring*

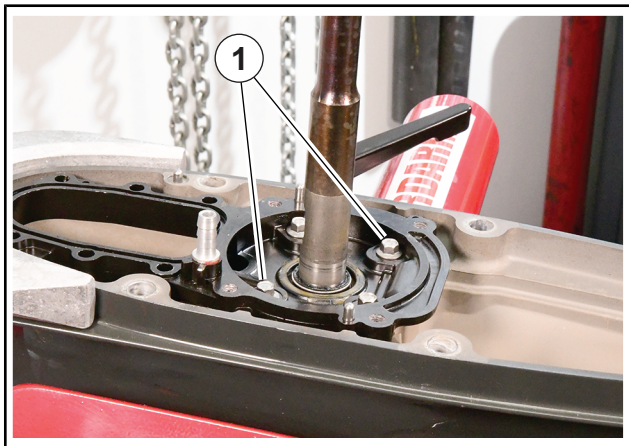
Required Tools
Slide Hammer **P/N 391008**
Remover **P/N 342681**

5. Use the Slide Hammer, P/N 391008, with Remover, P/N 342681, to loosen the propeller shaft bearing housing from the gearcase.

1. *Slider hammer and puller*

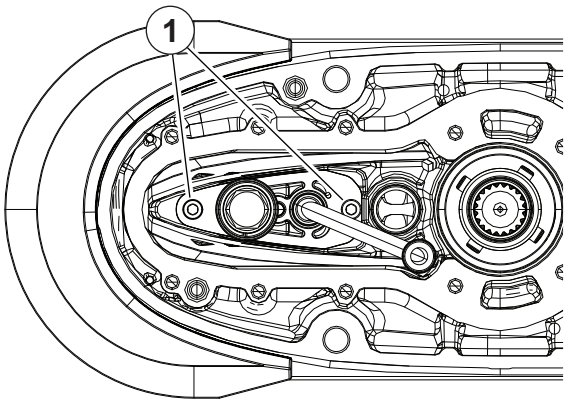
6. Remove the propeller shaft bearing housing from the gearcase housing.

7. Remove the 4 screws retaining the manifold and seal assembly.



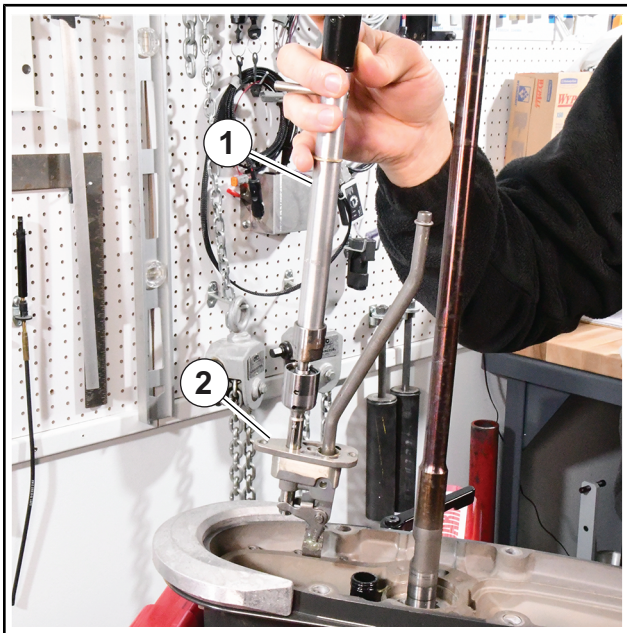
1. *Four screws*

8. Remove the manifold from the gearcase housing.
9. Use a 4 mm hex socket to remove the two screws retaining the shifter housing assembly to the gearcase housing.



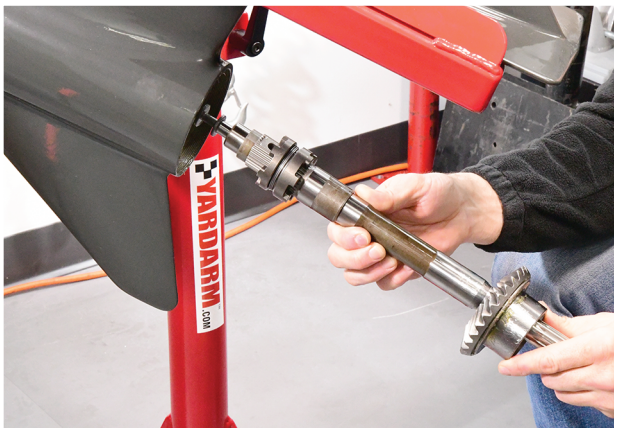
1. Two screws

10. Use the Shift Rod Installer/Remover Tool, P/N 358162, to remove the shifter housing assembly from the gearcase housing.



1. Shift Rod Installer/Remover Tool, P/N 358162
2. Shifter housing assembly

11. Use a suitable pick up tool, such as a flexible spring claw, to remove the cradle from the gearcase housing.
12. Remove the propeller shaft assembly, thrust washer, thrust bearing and gear from the gearcase housing.

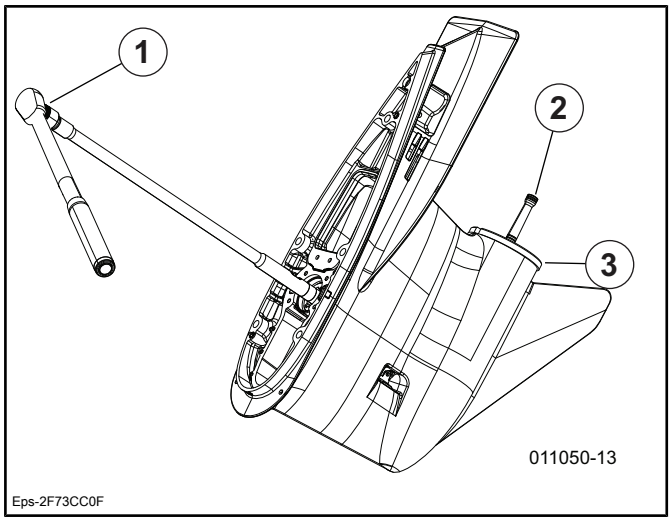


Pinion Gear and Driveshaft Removal

1.

Required Tools
Driveshaft Spline Socket **P/N 311875**
Alignment Fixture **P/N 360844**

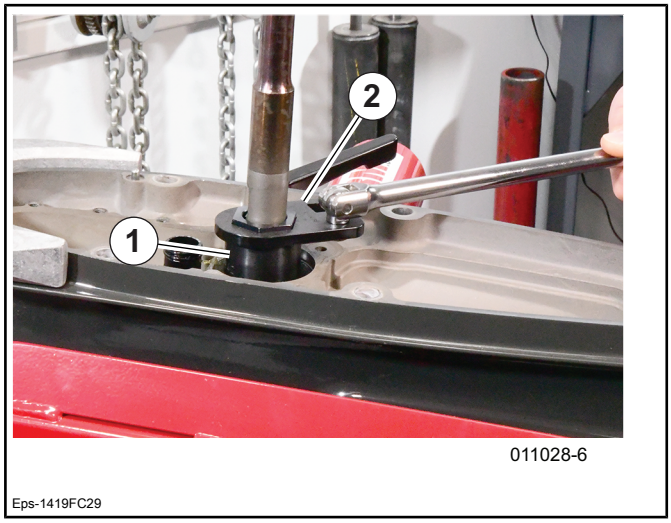
2. Use Driveshaft Spline Socket, P/N 311875, with a breaker bar, and an 8 mm hex socket with a breaker bar to LOOSEN the pinion gear retaining screw. Do NOT remove the screw.
3. Place Alignment Fixture, P/N 360844, over the gearcase housing and handle of the breaker bar as shown. The alignment fixture will hold the handle of the breaker bar and prevent damage to the threads of the gearcase housing.



1. *Driveshaft spline socket with breaker bar*
2. *Hex socket with breaker bar*
3. *Alignment fixture*

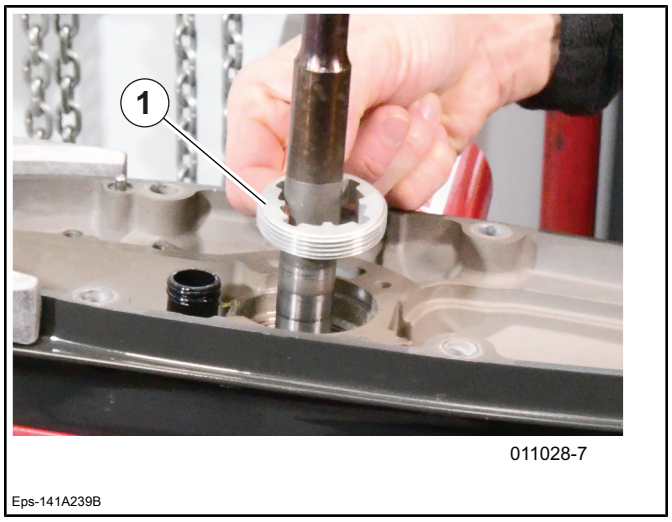
Required Tools
Spanner Nut Socket **P/N 360842**
Spanner Socket Wrench **P/N 360843**

4. Use Spanner Nut Socket, P/N 360842, with Spanner Socket Wrench, P/N 360843, to remove the driveshaft spanner nut.



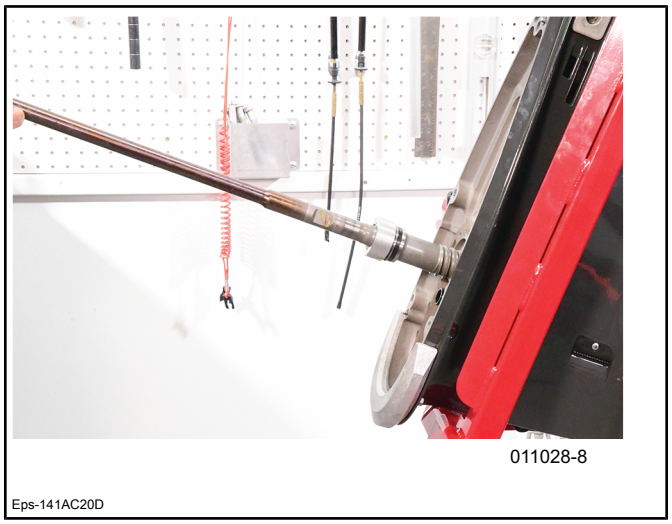
1. *Spanner Nut Socket, P/N 360842*
2. *Spanner Socket Wrench, P/N 360843*

5. Remove the spanner nut from the driveshaft.



1. *Driveshaft spanner nut*

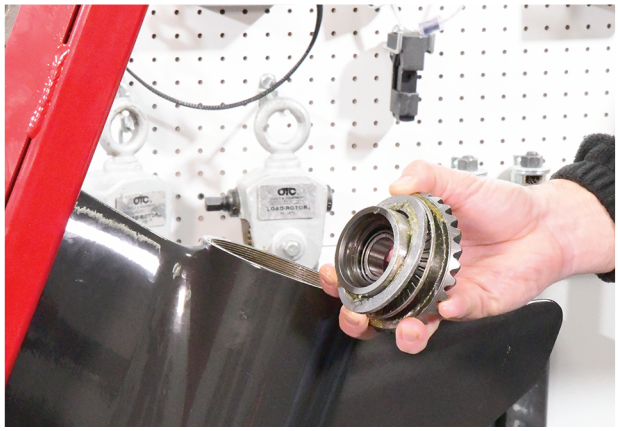
6. Use an 8mm hex socket to remove the pinion gear retaining screw.
7. Then remove the driveshaft and bearing assembly from the gearcase housing.



If driveshaft cannot be removed, refer to **Locked Driveshaft Removal**.

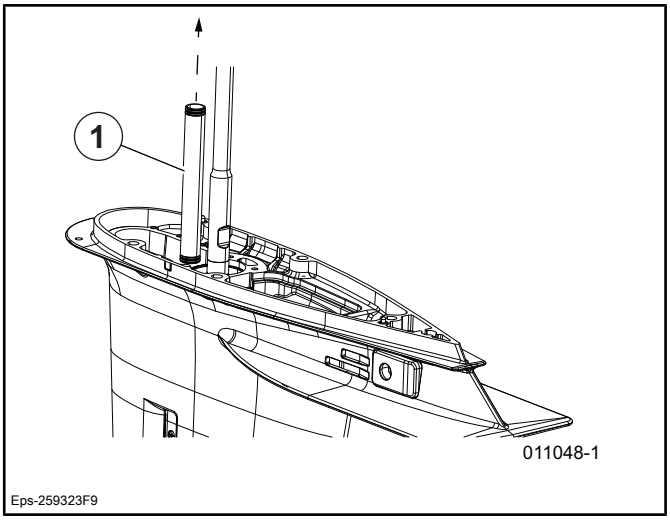
8. Then remove the pinon gear, washer and screw from the gearcase housing.

9. Remove the gear assembly from the gearcase housing.



Locked Driveshaft Removal

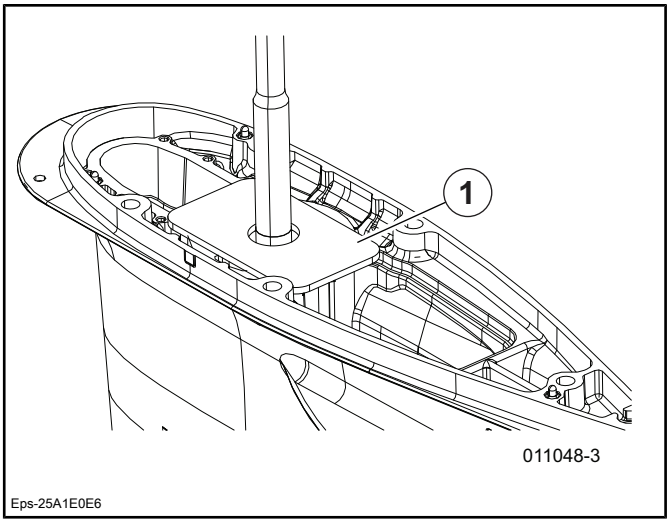
1. Make SURE the water tube is removed from the gearcase housing.



1. Water tube

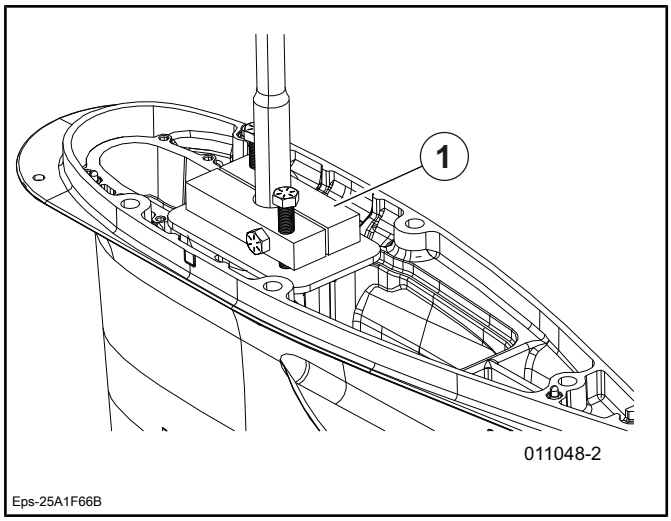
Required Tools
Driveshaft Puller
P/N 390706
Backing Plate
P/N 325867

2. The driveshaft to pinion taper is a locking taper. If necessary, use Driveshaft Puller, P/N 390706, and Backing Plate, P/N 325867, to break the lock.
3. Place the backing plate over the driveshaft as shown.



1. Backing plate, P/N 325867

4. Install the drive shaft puller as shown. Tighten the two horizontal screws to clamp the puller around the driveshaft.



1. Driveshaft puller, P/N 390706

5. Alternately tighten the two vertical screws against the backing plate until the driveshaft is loose from the pinion gear.

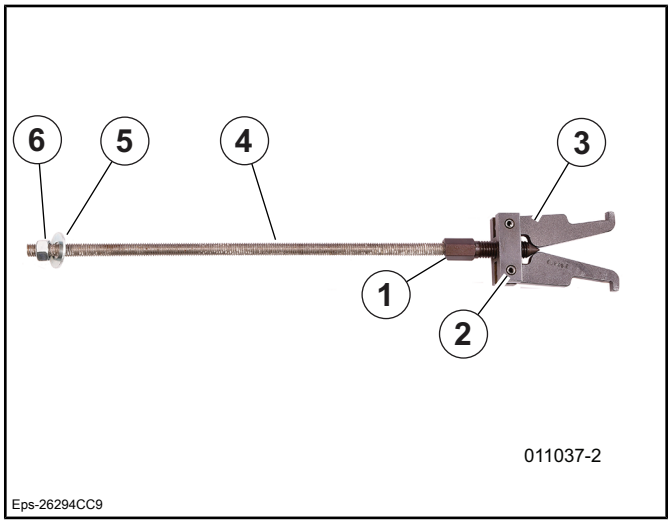
Front Bearing Removal

1. Assemble the required tools.

Required Tools	
Puller Shaft and Nut **P/N 360313**	
Puller Plate **P/N 363152**	
Wide Puller Jaws **P/N 391012**	
Extra Large Puller Jaws **P/N 360849**	

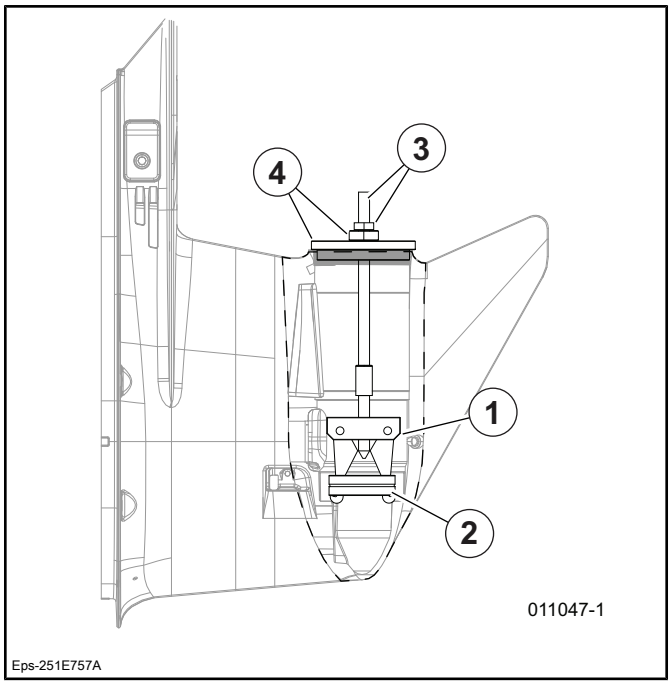
Additional Supplies
12 in. (305 mm) Threaded Rod 3/8 in. x 16 (obtain locally)
3/8 in. x 16 Hex Nut (obtain locally)
3/8 in. Flat Washer (obtain locally)

2. Make sure the threaded adapter is installed in the Wide Puller Jaws, P/N 391012.
3. Use a punch to remove the retaining pins from Wide Puller Jaws, P/N 391012.
4. Remove the jaws from the puller.
5. Install Extra Large Puller Jaws, P/N 360849, into the puller and replace the retaining pins.
6. Install the 3/8 in. x 16 threaded rod into the adapter.



1. Adapter
2. Pins
3. XL Puller jaws, P/N 360849
4. Threaded rod
5. Flat washer
6. Nit

7. Rotate the gearcase fixture as shown below.
8. Place tools into the gearcase housing as follows:
   1. Place the wide puller jaws into the gearcase housing, aligning the jaws with the slots in the housing. Tighten the puller adapter until the jaws fully engage the bearing assembly.
   2. Place Puller Plate. P/N 363152, over the gearcase housing and threaded rod.
   3. Place the thrust bearing from Puller Shaft, P/N 360313, over the threaded rod.
   4. Place the washer and nut onto the threaded rod.



1. *Wide Puller Jaws, P/N 391012*
2. *Front bearing*
3. *Threaded rod and nut*
4. *Puller Plate, P/N 362xxx, and thrust bearing from Puller Shaft, P/N 360313*

9. Use a heat gun to heat the gearcase housing.

NOTICE

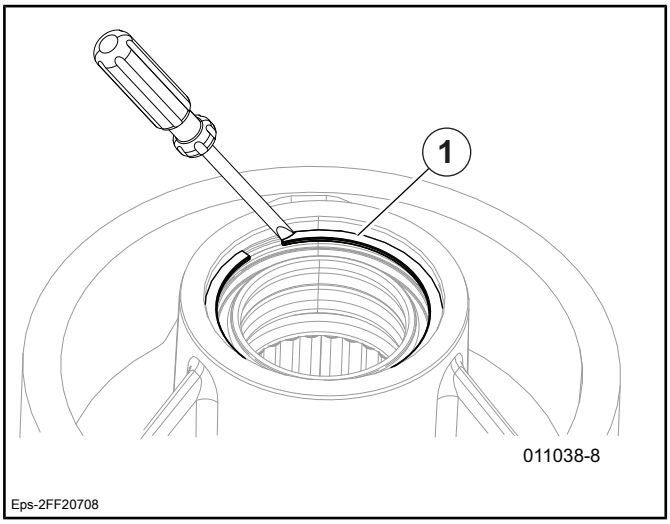
Move heat gun continuously over the gearcase housing to avoid damaging painted surfaces.

10. Use a wrench to tighten the nut.
11. After the bearing is removed from the gearcase housing, remove the tools and bearing from the housing.
12. Clean the housing thoroughly with solvent.

Propeller Shaft Bearing Housing Service

Retaining Ring Removal

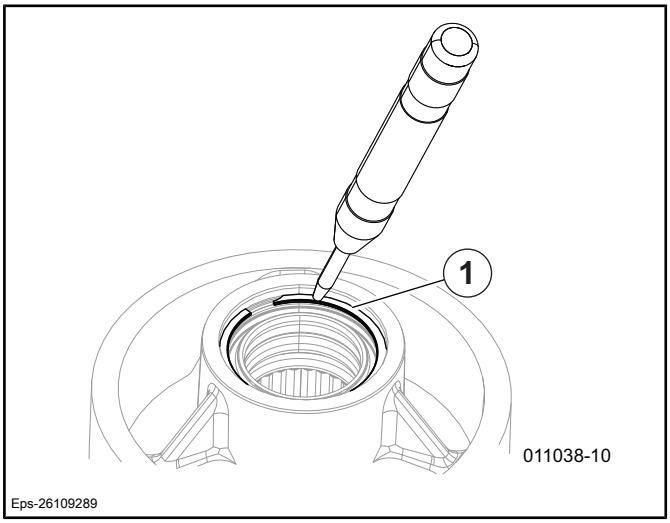
1. Use a suitable tool to remove the retaining ring from the groove.



1. Retaining ring

Retaining Ring Installation

1. Install one end of the retaining ring into its retaining groove. Use a punch to work the retaining ring into the groove.



1. Retaining ring

Rear Seal Removal

A retaining ring is used to retain the seal.

1. Remove the retaining ring. Refer to **Retaining Ring Removal**.

Required Tool
Puller Bridge
P/N 432127
Puller Jaws
P/N 432131

2. Use Puller Bridge, P/N 432127, with Puller Jaws, P/N 432131 to remove the seals.

Rear Seal Installation

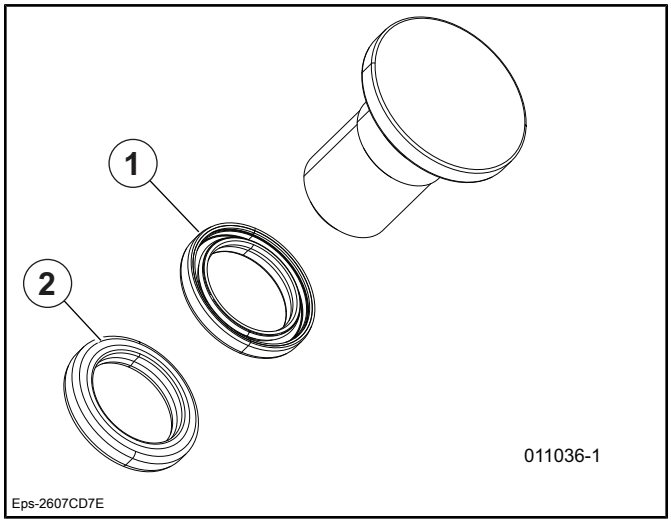
1. Apply *Triple Guard* grease to the seal lips before installing.

Required Tool
Seal Installer
P/N 362025

Required Chemical
Triple Guard Grease
P/N 508298
Gasket Sealing Compound
P/N 508235

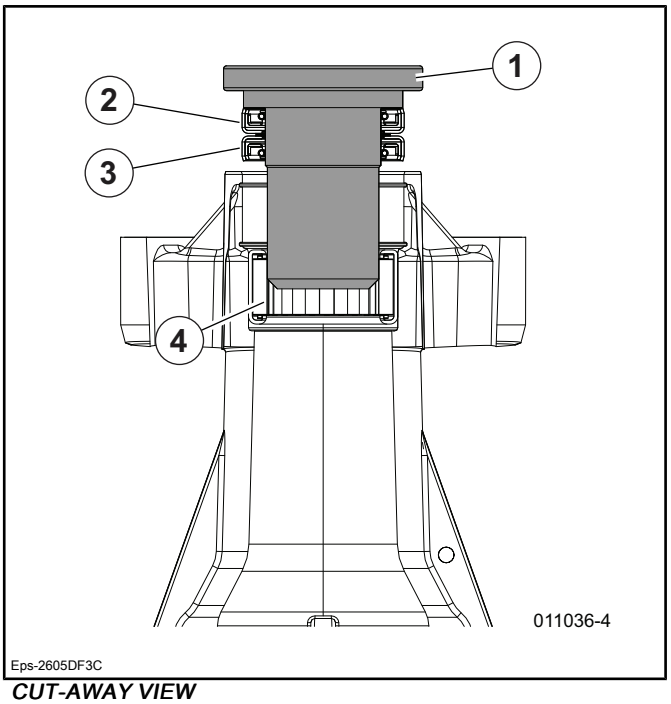
2. Use Seal Installer, P/N 362025, to install new seals in bearing housing. Both seals are installed at the same time.

– Place the outer seal on the seal installer first, so the lip will be facing away from the bearing housing.
– Place the inner seal on the seal installer second, so the lip will be facing toward the bearing housing.



1. Outer seal
2. Inner seal

3. Apply *Gasket Sealing Compound* to the metal casing of both seals.
4. Insert the seal installer with both seals, into the bearing housing. The installer uses the rear bearing to align and guide the seal installation. Take the bearing housing and seal installer to a press and press the seals into the bearing housing until seated.

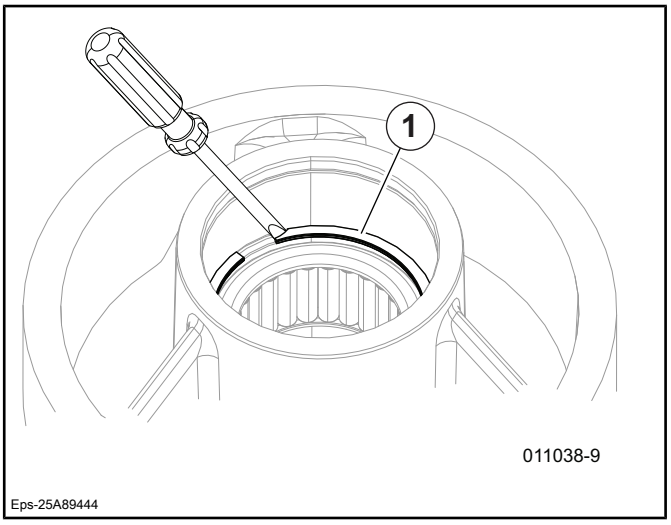


CUT-AWAY VIEW
1. Seal installer, P/N 362024
2. Outer seal
3. Inner seal
4. Rear bearing

Propeller Shaft Rear Bearing Removal

Late models use a retaining ring to improve bearing retention.

1. Insert the blade of a small screw driver between the notch in the retaining ring and the bearing housing.
2. Turn the screw driver to move the end of the retaining ring from its retaining groove.



1. Retaining ring

3. Use a curved pick to work the snap ring up from the retaining groove.
4. Remove the snap ring.

Required Tool
Puller Bridge **P/N 432127**
Large Puller Jaws **P/N 432129**

5. Use Puller Bridge, P/N 432127, with Puller Jaws, P/N 432129, to remove the bearing.

need new pic

6. Discard the bearing housing O-ring.
7. Clean the housing and bearings in solvent and dry thoroughly.
8. If bearings were not replaced, rotate the needles to check for freedom of movement.
9. Inspect the O-ring groove.
10. Use emery cloth to remove any sharp edges that might cut the O-ring.
11. Remove any nicks or burrs on front of bearing housing.

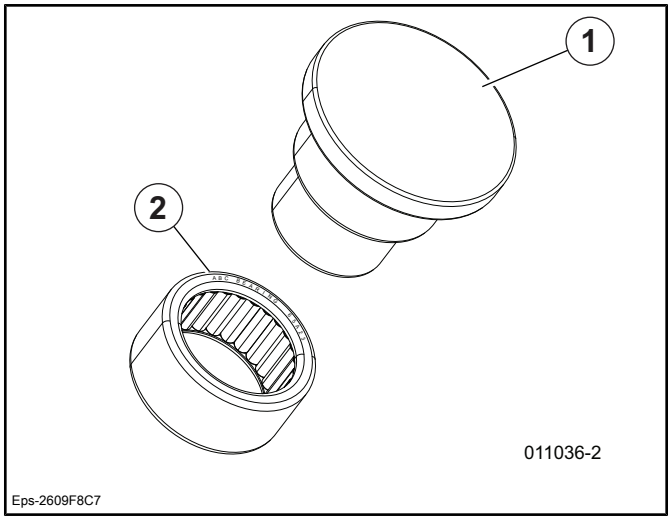
Propeller Shaft Rear Bearing Installation

1. Apply gearcase lubricant to the bearing needles and to the outside of the bearing case. Then install the bearing in bearing housing as follows.

Required Tools
Bearing Installer **P/N 362024**

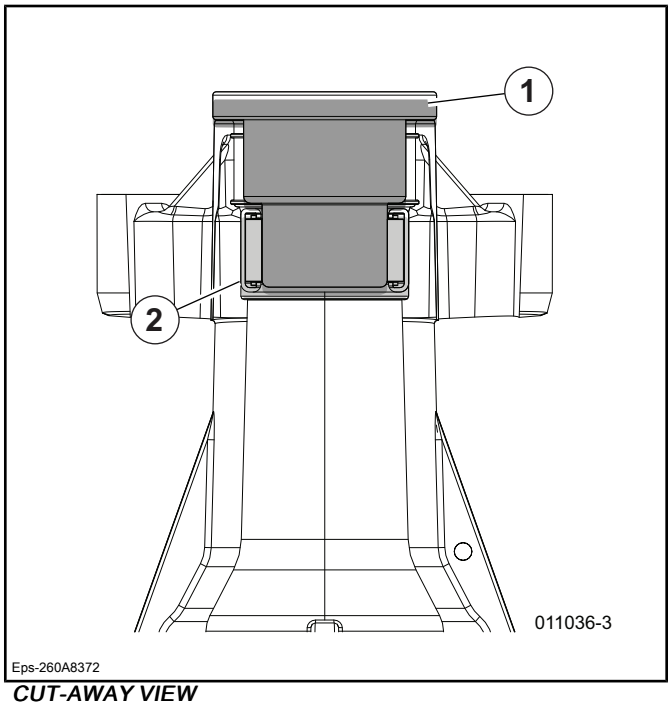
2. Place the lettered side of the bearing case on the bearing installer.

IMPORTANT: When installed, the lettered end of the bearing should be visible.



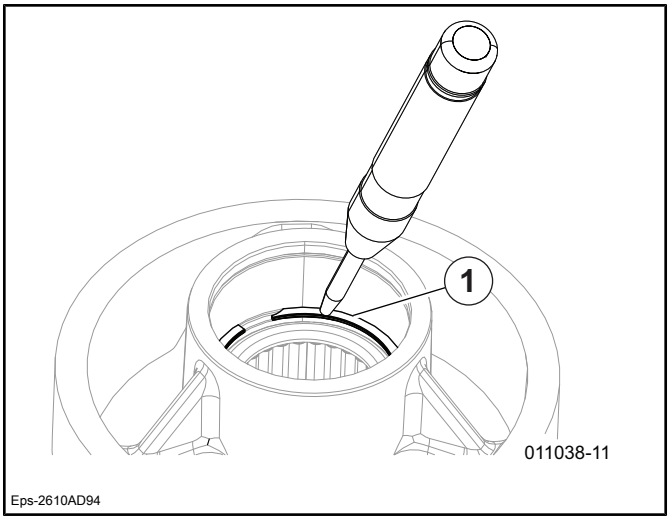
1. Bearing installer, P/N 362024
2. Bearing lettered side

3. Insert the bearing installer and bearing into the bearing housing. Take the bearing housing and bearing installer to a press and press the bearing into the bearing housing until seated.



CUT-AWAY VIEW
1. Bearing installer, P/N 362024
2. Bearing

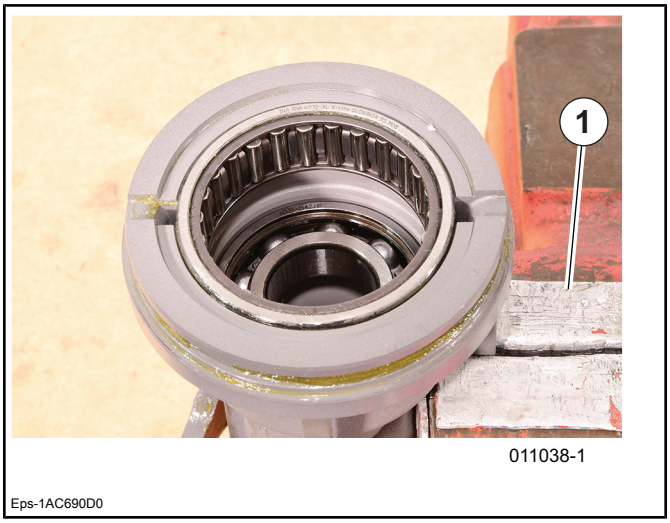
4. Install one end of the retaining ring into its retaining groove. Use a punch to work the retaining ring into the groove.



1. Retaining ring

Forward Bearing Removal

1. Place the propeller shaft bearing housing in a vise equipped with soft jaws, to prevent damaging the housing.

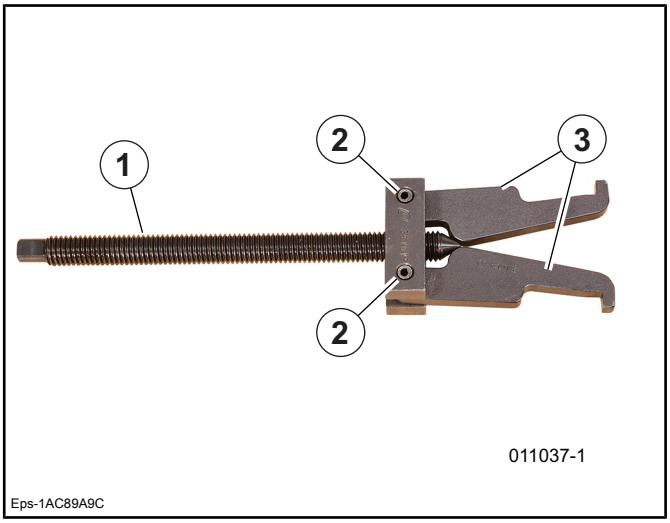


1. Soft jaw set

Required Tools
Puller Bridge
P/N 360312
Puller Shaft and Nut
P/N 360313
Puller Plate
P/N 360314

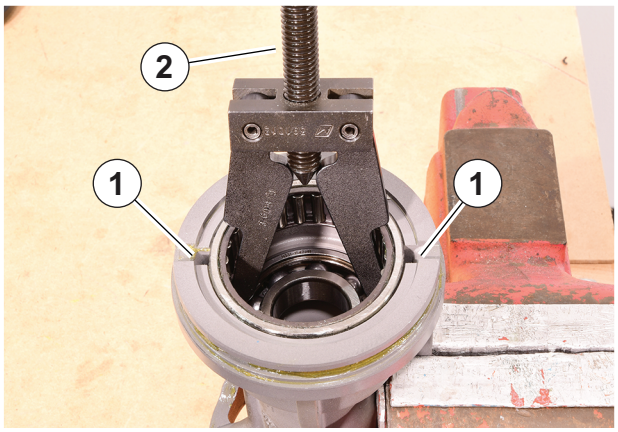
Required Tools
Wide Puller Jaws
P/N 391012
Extra Large Puller Jaws
P/N 360849

2. Remove the adapter from Wide Puller Jaws, P/N 391012, and replace with the Puller Shaft, from Puller Shaft and Nut, P/N 360313.
3. Use a punch to remove the retaining pins from Wide Puller Jaws, P/N 391012.
4. Remove the jaws from the puller.
5. Install Extra Large Puller Jaws, P/N 360849, into the puller and replace the retaining pins.



1. Puller shaft
2. Retaining pins
3. XL Puller Jaws, P/N 360849

6. Install the puller into the bearing housing, aligning the jaws with the slots in the housing. Tighten the puller shaft until the jaws fully engage the bearing assembly.



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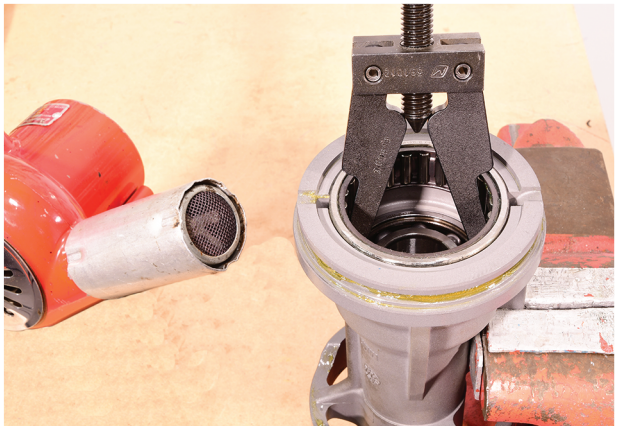
1. *Slot*
2. *Puller shaft*

7. Use a heat gun to heat the bearing housing.



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8. Place the Puller Bridge, P/N 360312, on the housing. Then place the Puller Plate, P/N 360314 on the puller bridge.
9. Then install the thrust bearing and nut from Puller Shaft and Nut, P/N 360313, on the puller shaft.

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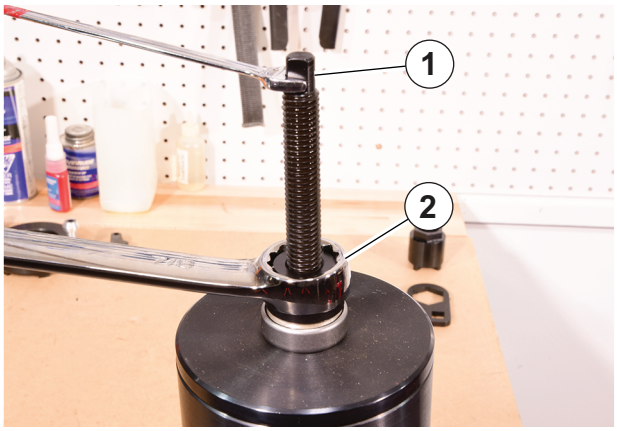
Eps-1AC77EDA

1. *Puller Bridge, P/N 360312*
2. *Puller Plate, P/N 360314*
3. *Thrust bearing*
4. *Nut*

10. Use a 5/16 im (8 mm) wrench to hold the puller shaft, while tightening the nut with a 7/8 in (22 mm) wrench.



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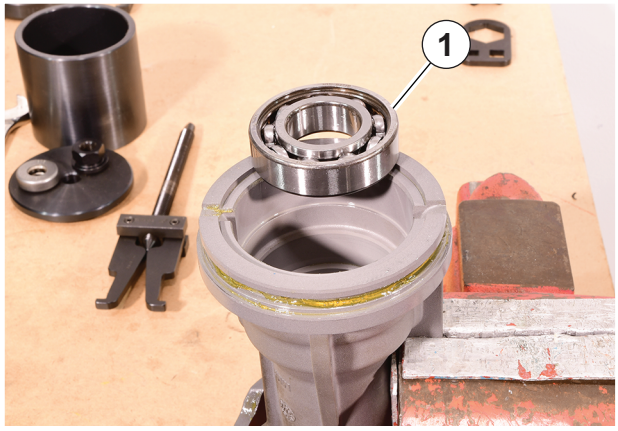
1. *5/16 in (8 mm) wrench*
2. *7/8 in. (22 mm) wrench*

11. After the bearing is removed from the housing, remove the tools and bearing from the housing.

1. Bearing

12. Remove the ball bearing assembly from the housing.

The ball bearing assembly is a slip-fit and can be removed by hand.



1. Ball bearing assembly

13. Remove the bearing housing from the vise.
14. Clean the housing thoroughly with solvent.

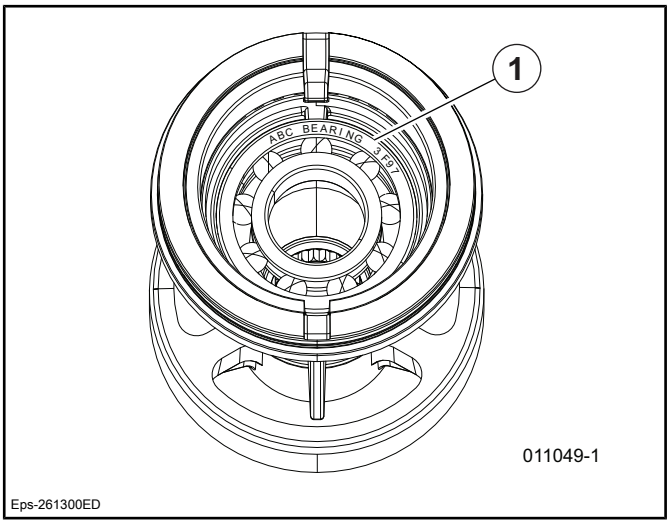
Forward Bearing Installation

1. Apply gearcase lubricant to ball bearings, bearing needles and to the outside of the bearing cases. Then install bearings in gearcase housing as follows.

Required Tools
Bearing Installer
P/N 360315

2. Install the ball bearing assembly into the gearcase housing with the lettered end facing out.

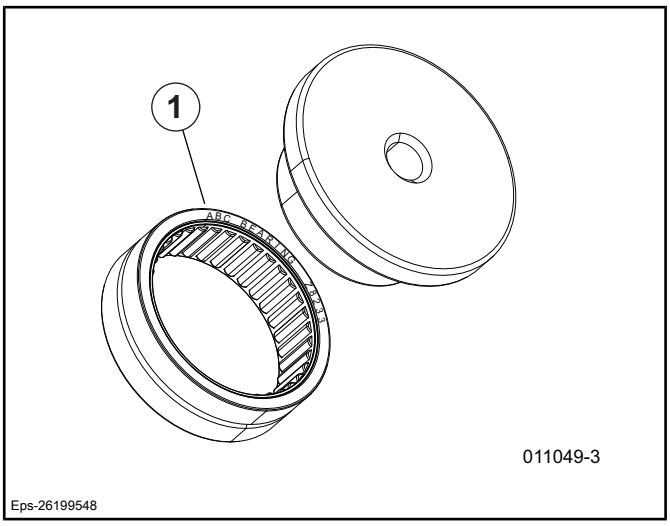
IMPORTANT: When installed, the lettered end of the bearing should be visible.



1. Lettered side of bearing

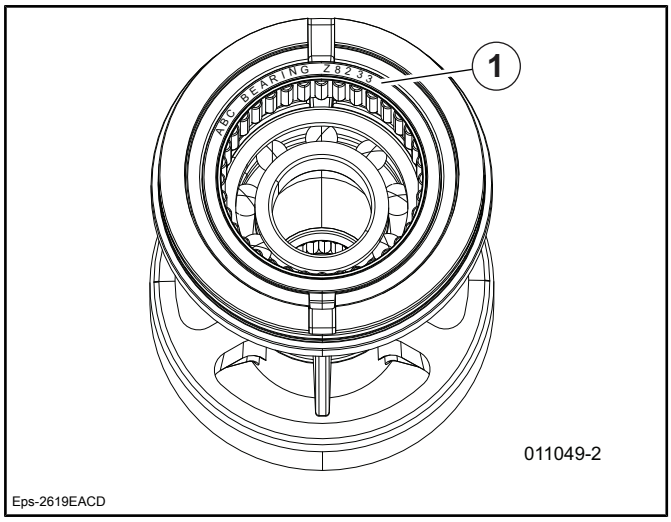
3. Place the lettered end of the bearing case on the bearing installer.

IMPORTANT: When installed, the lettered end of the bearing should be visible.



1. Lettered side of bearing

4. Take the bearing housing and bearing installer to a press and press the bearing into the bearing housing until seated.

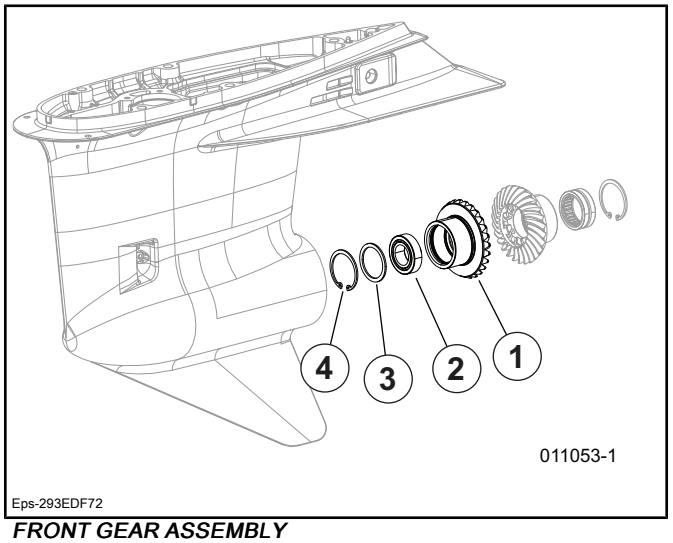


1. Lettered end of bearing

Gear Assembly Service

The gear assemblies used in the SLX-2 gearcase are identified by their location in the gearcase housing, either front or rear. The gear in the front location is installed into a roller bearing in the gearcase housing. The gear in the rear location is installed into a roller bearing in the propeller shaft bearing housing. The gears MUST be installed in the locations identified below and must NOT be swapped.

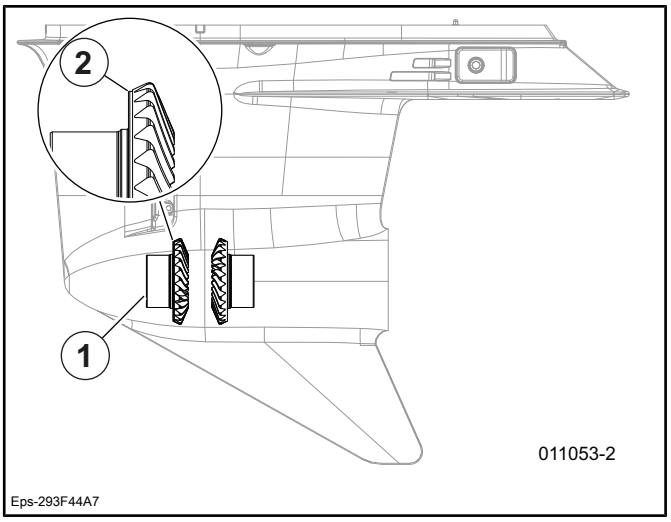
The gear assembly used in the front location contains the gear, a tapered roller bearing, a spacer and a retaining ring.



FRONT GEAR ASSEMBLY

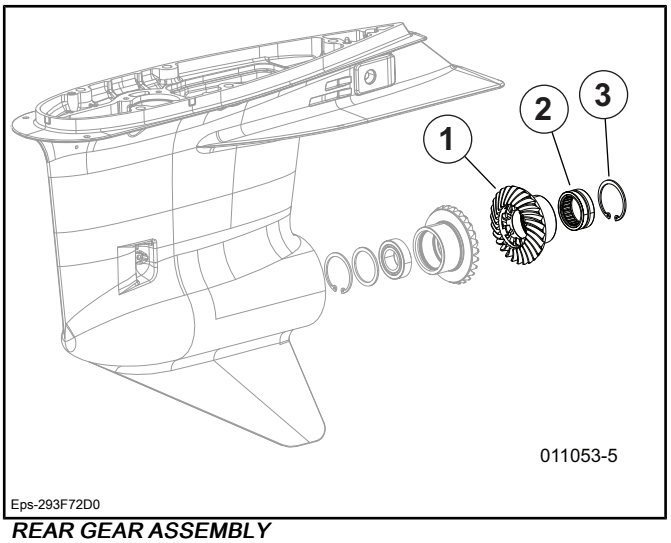
1. *Gear*
2. *Tapered roller bearing*
3. *Spacer Retaining ring*
4. *Retaining ring*

The gear used in the front location can be identified by a groove around the outer diameter of the gear.



1. *Front location gear*
2. *Identification groove*

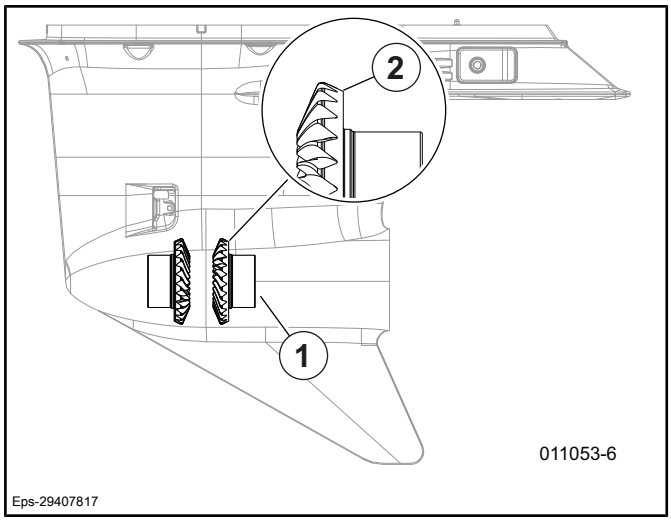
The gear assembly used in the rear location contains the gear, a roller bearing and a retaining ring.



REAR GEAR ASSEMBLY

1. *Gear*
2. *Roller bearing*
3. *Retaining ring*

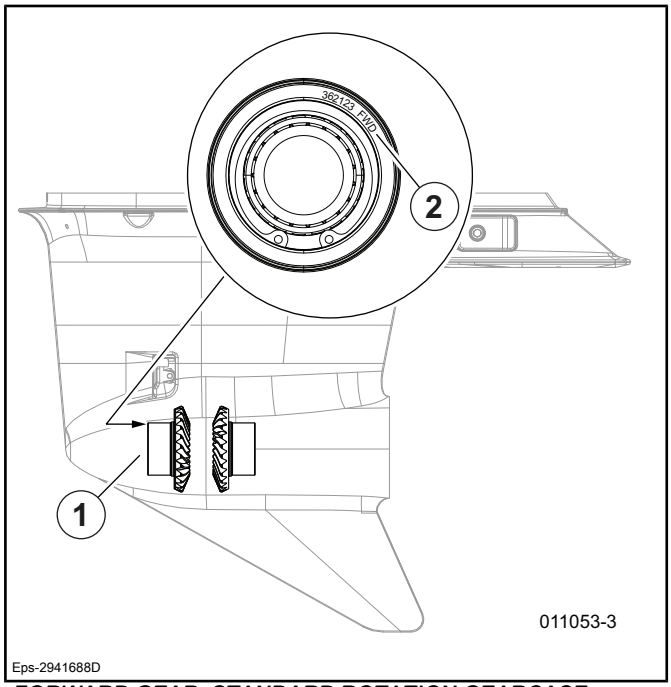
The gear used in the rear location does NOT have a groove around the outer diameter of the gear.



1. Rear location gear
2. Identification — NO groove

In a standard rotation gearcase, the gear in the front location is the FORWARD gear and is identified by part number and the letters “FWD” following the part number. Refer to the Electronic Parts Catalog (EPC) for the correct gear part numbers.

IMPORTANT: The FORWARD gear and pinion are a matched set, individual gears are NOT available. A service replacement gearset contain the FORWARD, REVERSE and pinion gears.

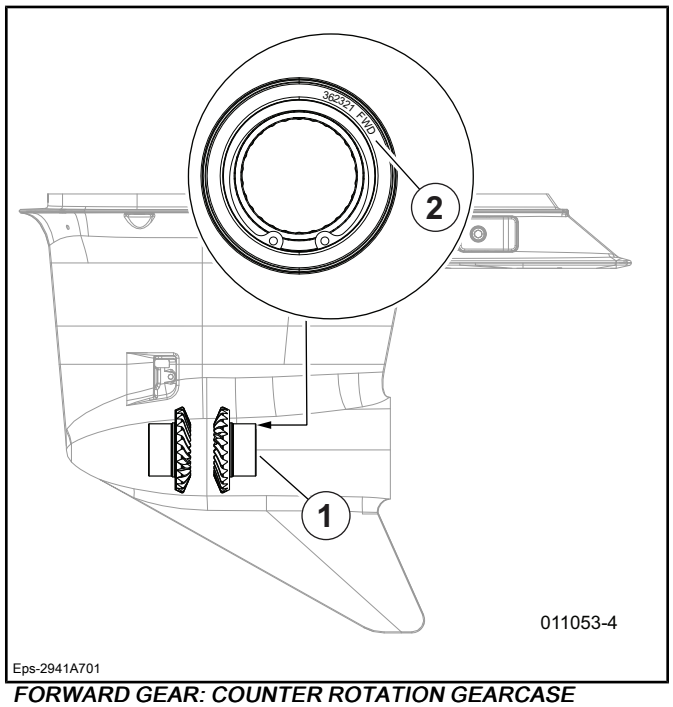


FORWARD GEAR: STANDARD ROTATION GEARCASE

1. Forward gear
2. “FWD” identification

In a counter rotation gearcase, the gear in the rear location is the FORWARD gear and is identified by part number and the letters “FWD” following the part number. Refer to the Electronic Parts Catalog (EPC) for the correct gear part numbers.

IMPORTANT: The FORWARD gear and pinion are a matched set, Individual gears are NOT available. A service replacement gearset contain the FORWARD, REVERSE and pinion gears.



FORWARD GEAR: COUNTER ROTATION GEARCASE

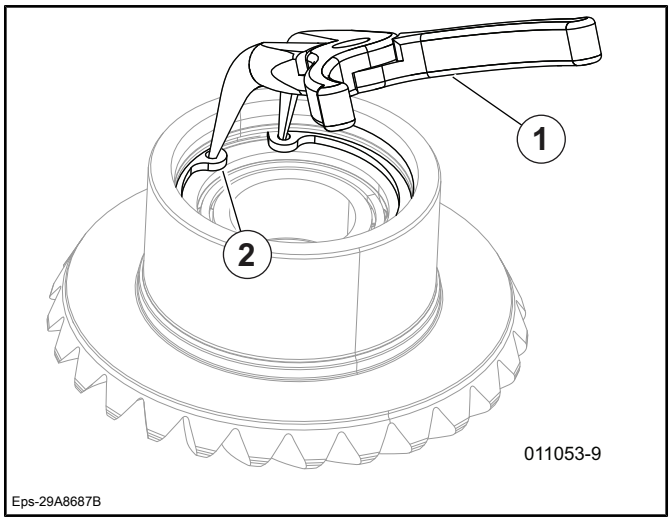
1. Forward gear
2. “FWD” identification

Forward Gear Bearing Service

The bearing is a slip fit and can be removed and installed without special tools.

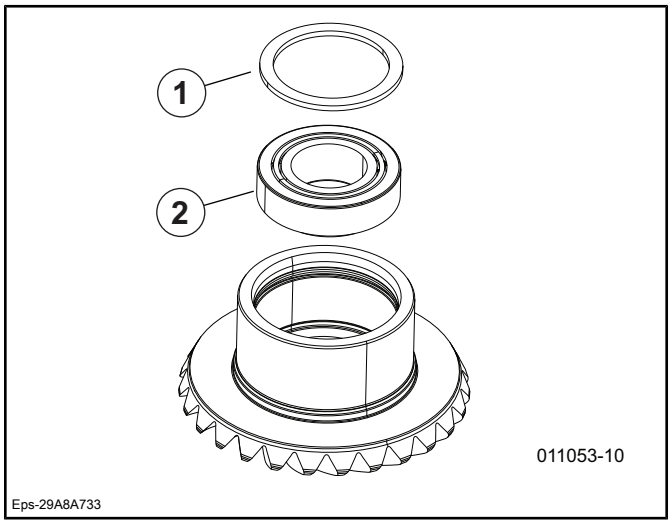
Bearing Removal

1. Use a set of retaining ring pliers to remove the retaining ring from the gear assembly.



1. Retaining ring pliers
2. Retaining ring

2. Remove the spacer from the gear.
3. Remove the bearing from the gear.



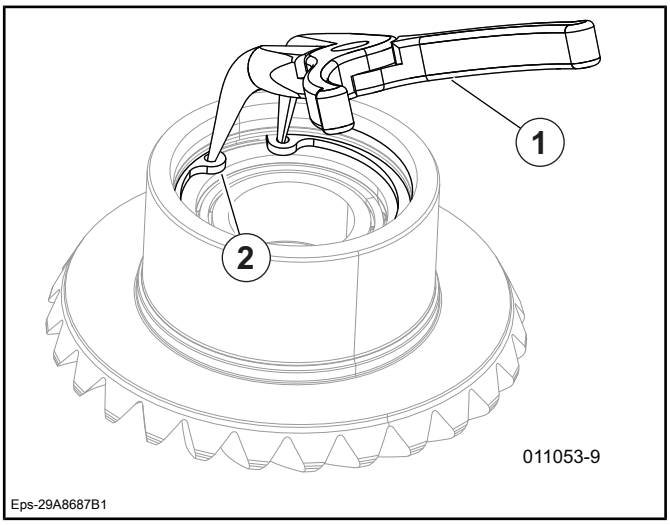
1. Spacer
2. Bearing

4. Inspect the bearing for wear or damage.
5. Replace a worn or damaged bearing.

Bearing Installation

Required Chemical
Gearcase Lubricant (HPF Pro) P/N 508298

6. Apply gearcase lubricant to the bearing case and rollers.
7. Install the bearing into the gear assembly. The lettered side of bearing case should be visible when the bearing is installed.
8. Install the spacer into the gear assembly.
9. Use a set of retaining ring pliers to install the retaining ring into the gear assembly.



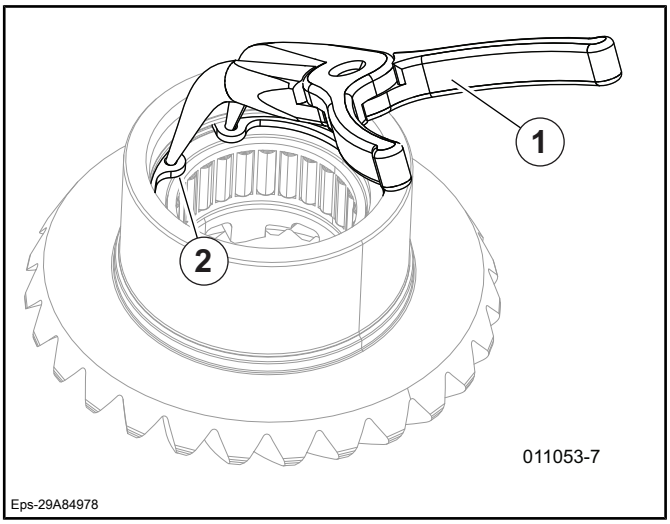
1. Retaining ring pliers
2. Retaining ring

Rear Gear Bearing Service

The bearing is a slip fit and can be removed and installed without special tools.

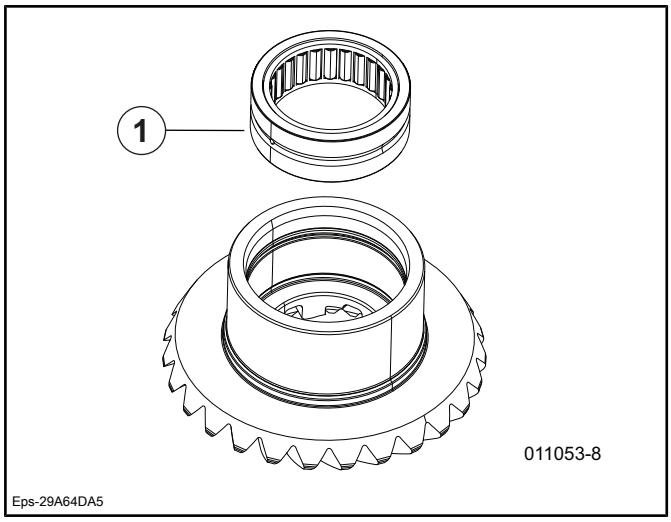
Bearing Removal

1. Use a set of retaining ring pliers to remove the retaining ring from the gear assembly.



1. Retaining ring pliers
2. Retaining ring

2. Remove the bearing from the gear.



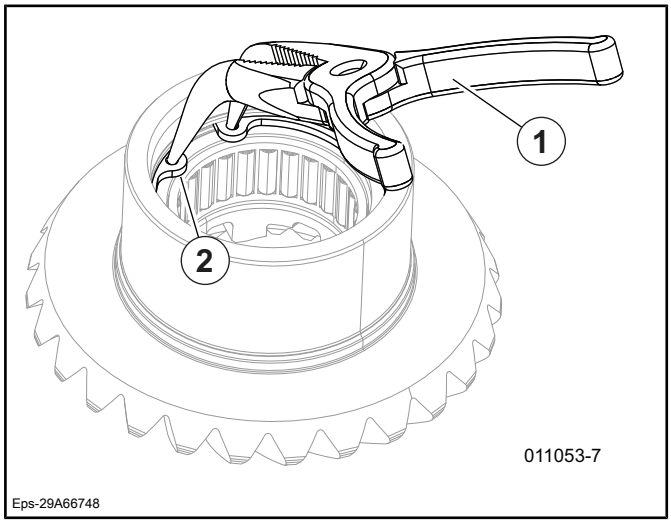
1. Bearing

3. Inspect the bearing for wear or damage.
4. Replace a worn or damaged bearing.

Bearing Installation

Required Chemical
Gearcase Lubricant (HPF Pro) **P/N 508298**

5. Apply gearcase lubricant to the bearing case and rollers.
6. Install the bearing into the gear assembly. The lettered side of bearing case should be visible when the bearing is installed.
7. Use a set of retaining ring pliers to install the retaining ring into the gear assembly.

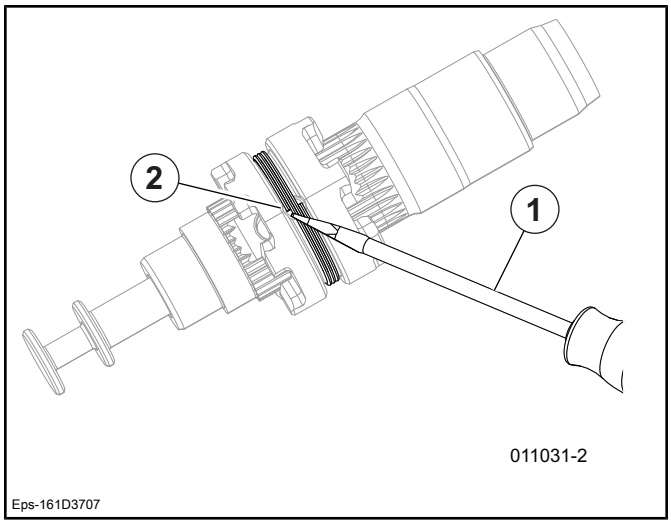


1. Retaining ring pliers
2. Retaining ring

Propeller Shaft Service

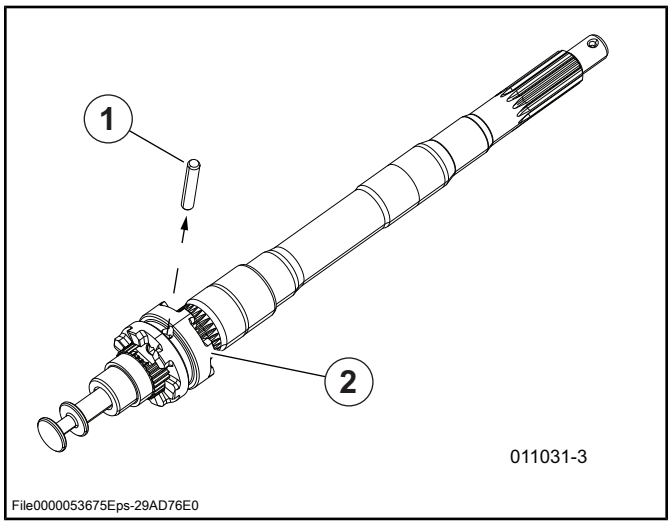
Propeller Shaft Disassembly

1. Insert a suitable tool under one end of the clutch dog spring and remove it from its groove by unwrapping it from around the clutch dog. **Discard the spring.**



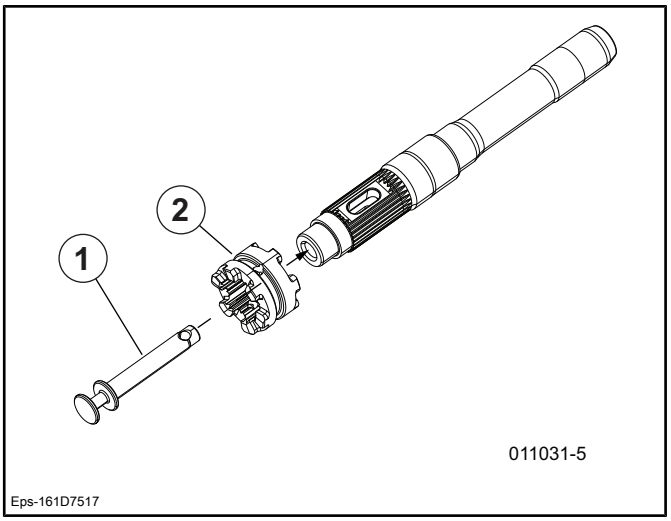
1. Tool
2. Spring

2. Remove the pin from the clutch dog.



1. Pin
2. Clutch dog

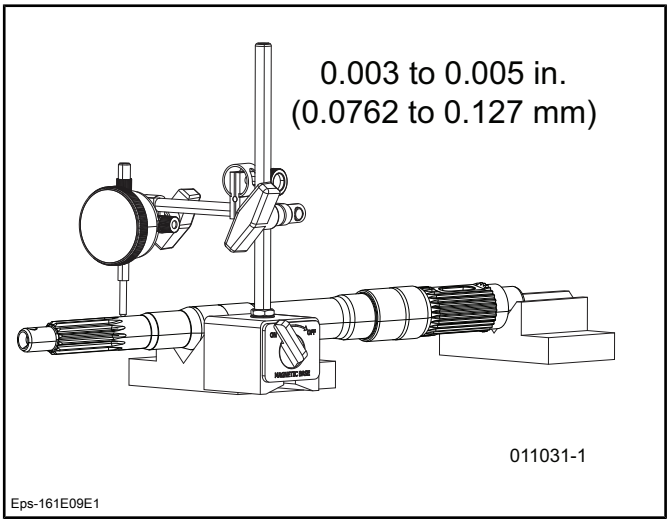
3. Remove the shifter shaft and clutch dog from the propeller shaft.



1. Shifter shaft
2. Clutch dog

Propeller Shaft Inspection

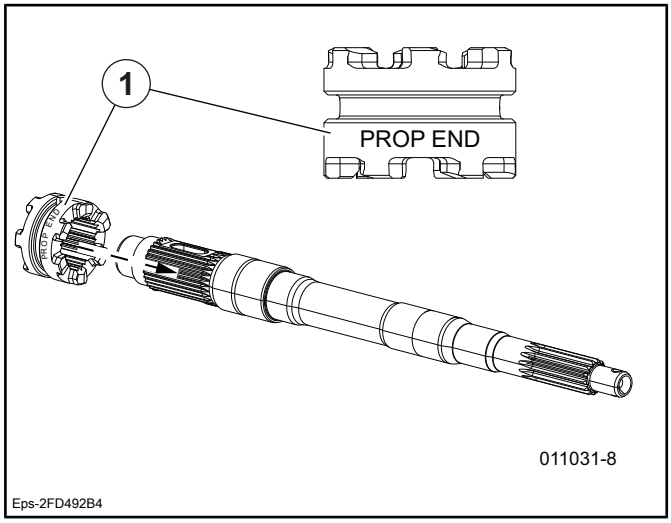
1. Thoroughly clean all parts with solvent.
2. Inspect the splines of the propeller shaft and clutch dog for wear or damage. Replace worn parts.
3. Check the propeller shaft run-out.
   1. Set up a dial indicator and set of “V–Blocks” on a surfacing block.
   2. Place the propeller shaft in the “V–Blocks”.
   3. Zero the dial indicator.
   4. Rotate the propeller shaft and observe the dial indicator readings.



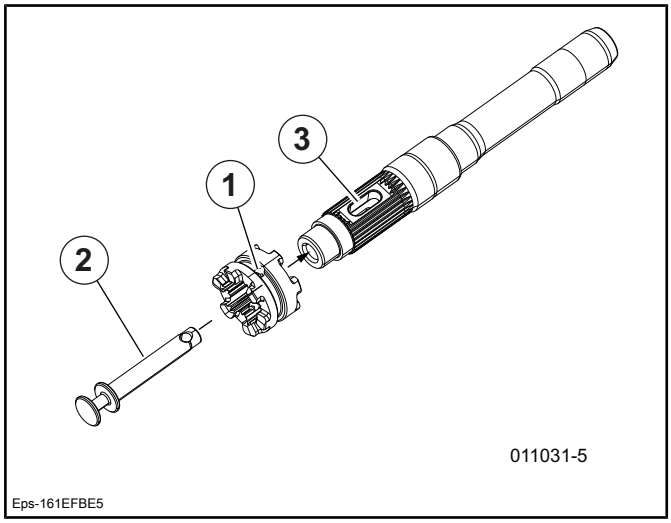
   Run–out should be 0.003 to 0.005 in (0.0762 to 0.127 mm).
4. If run– out exceeds 0.005 in. (0.127 mm) replace the propeller shaft.

Propeller Shaft Assembly

1. Align the hole in the clutch dog with the slot in the propeller shaft. Then install the clutch dog on the propeller shaft, with “PROP END” facing the rear of the propeller shaft.
2. Install the shifter shaft into the propeller shaft, aligning the hole for the pin, with the hole in the clutch dog.

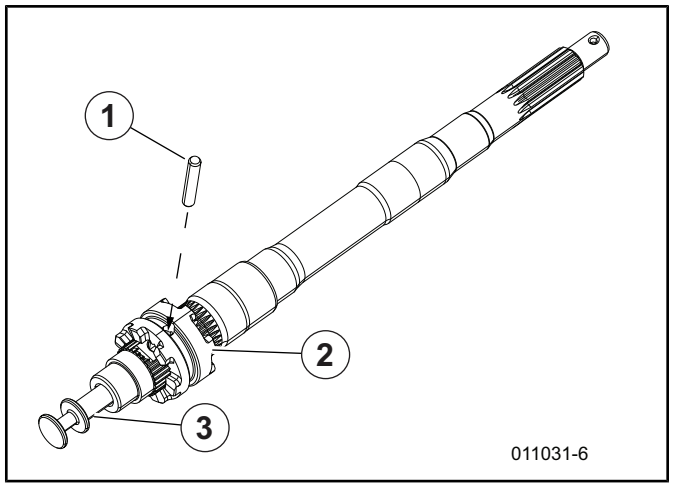


1. PROP END



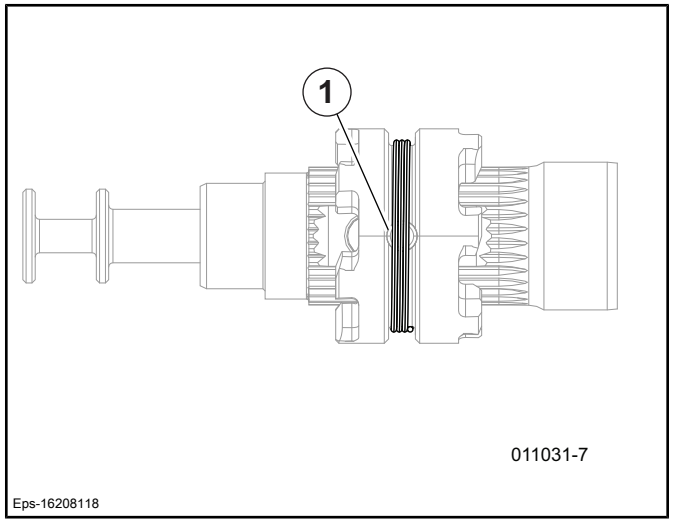
1. Hole in clutch dog
2. Shifter shaft
3. Slot

3. Install the pin through the clutch dog and shifter shaft.



1. Pin
2. Clutch dog
3. Shifter shaft

4. Install a **NEW** spring around the clutch dog to retain the pin. Place three coils over each end of the pin, MAKING SURE NONE OF THE COILS OVERLAP OR ARE LOOSE.



1. Three coils over pin

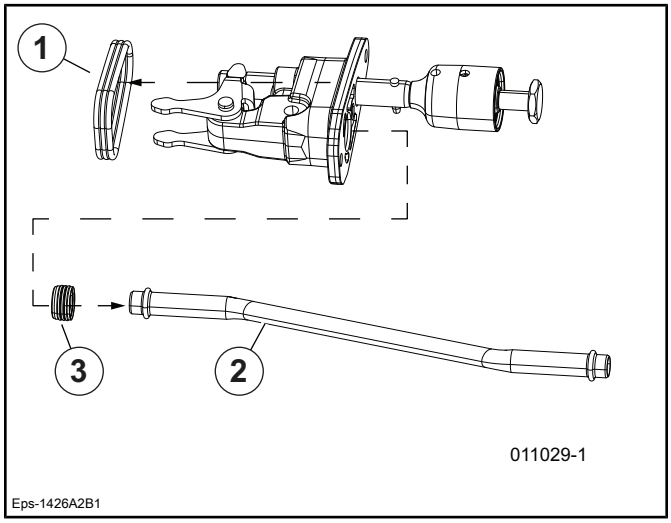
Shift Housing Service

Shift Housing Disassembly

⚠ WARNING

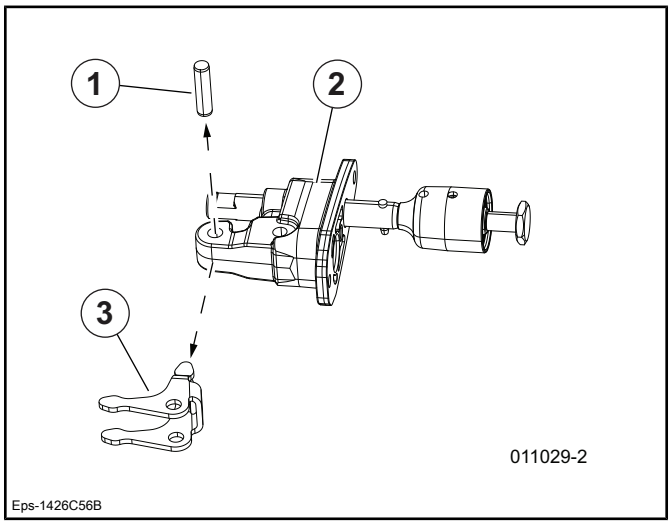
Wear safety glasses to avoid injury.

1. Remove the seal from the housing. Then remove the oil tube and oil tube seal.



1. Seal
2. Oil tube
3. Oil tube seal

2. Remove the shift lever pin from the housing. Then remove the shift lever.

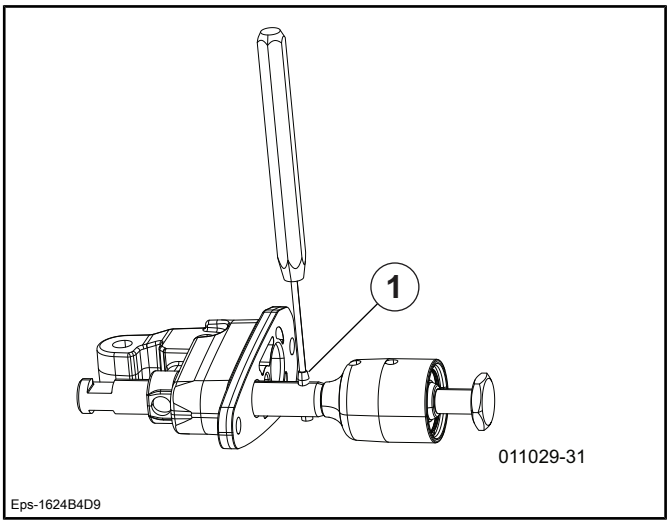


1. Pin
2. Shifter housing
3. Shift lever

⚠ WARNING

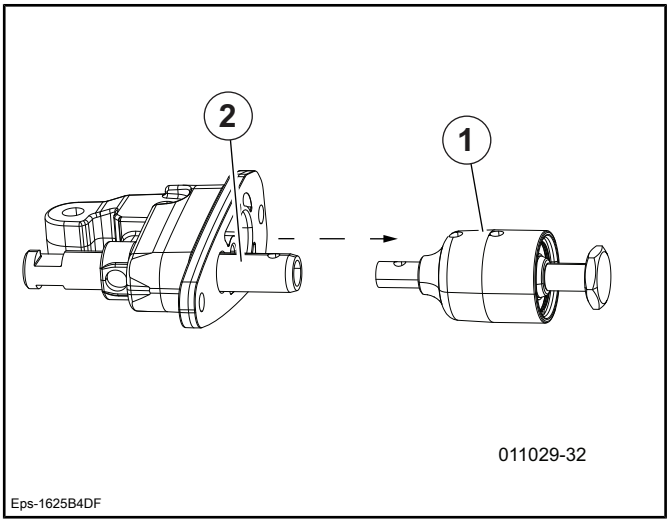
Wear safety glasses to avoid personal injury. The detent ball and spring and come out with great force.

3. Use a small punch to push the pin out of the detent assembly — Push from the tapered end of the pin.



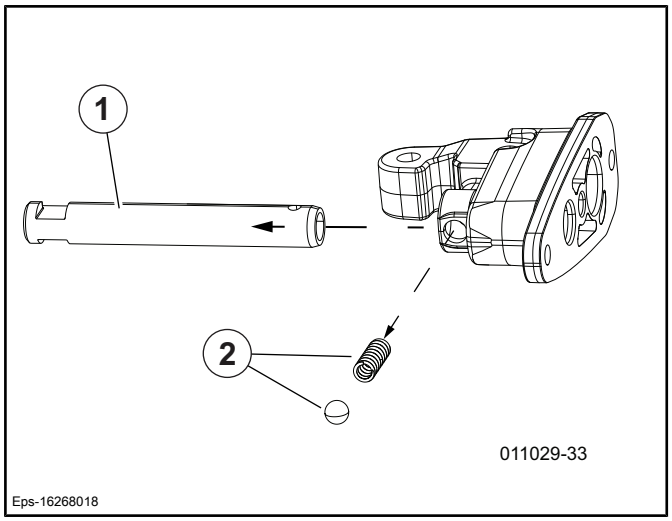
1. Tapered end of pin

4. Remove the detent assembly and shift rod from the detent shaft.



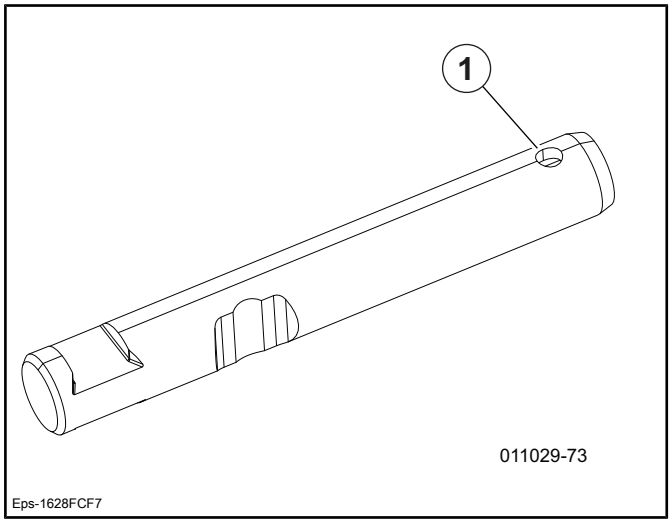
1. Detent assembly and shift rod
2. Detent shaft

5. Wrap the housing with a shop towel to catch the ball and spring.
6. Pull the detent shaft out of the housing in the direction indicated.



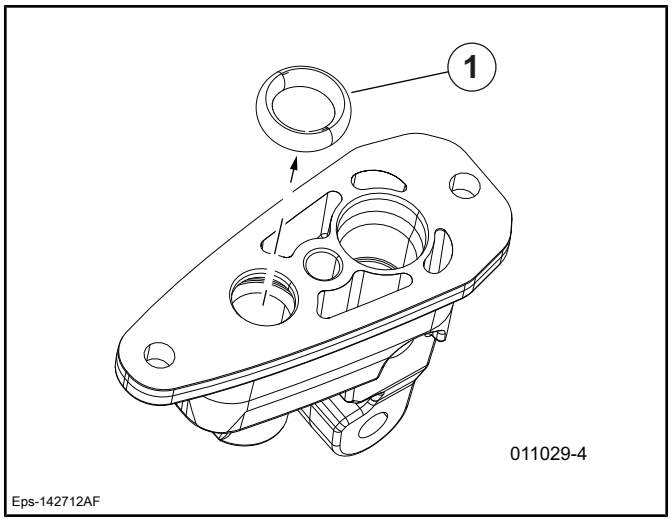
1. Detent shaft
2. Ball and spring

7. Remove the ball and spring from the shop towel.
8. Inspect the detent shaft. Ensure there are no burs or rough edges on either side of the pin hole. During installation, rough edges can damage the o-ring seal in the shifter housing. Replace the detent shaft, or smooth any rough edges.



1. Pin hole

9. Use a suitable tool, such as a small pick, to remove the o-ring from the housing.

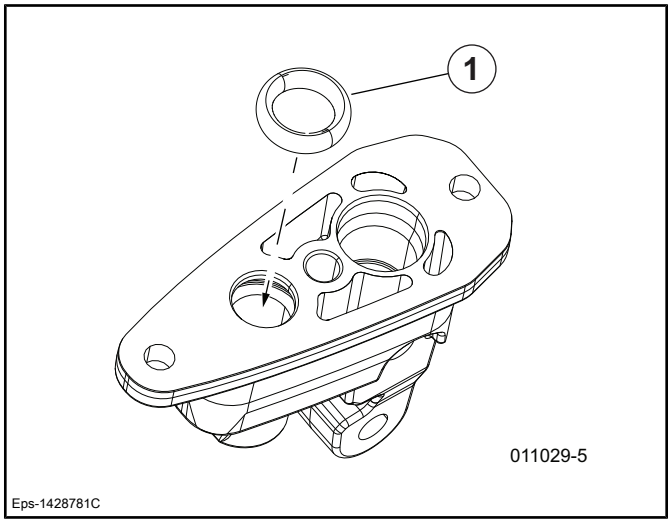


1. O-ring

Shift Housing Assembly

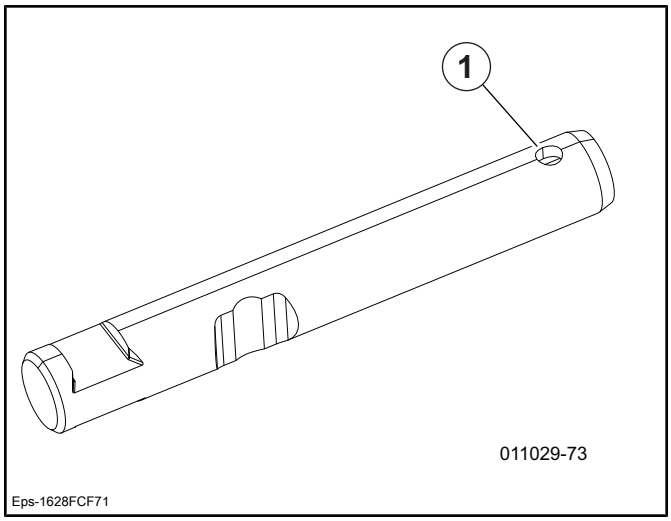
IMPORTANT: Clean and inspect all parts before beginning assembly procedures. Replace any damaged parts.

1. Apply *Triple Guard* grease to a new o-ring.
2. Carefully install the o-ring into the housing with a suitable tool. Do NOT use any sharp tool which could damage the o-ring.



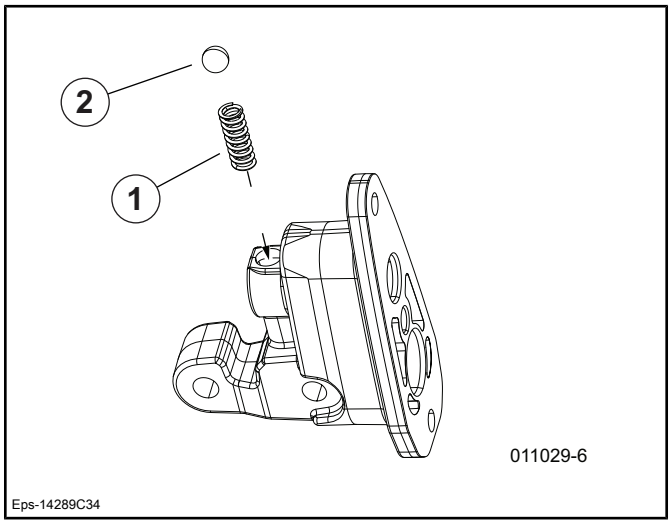
1. O-ring

3. Inspect the detent shaft. Ensure there are no burs or rough edges on either side of the pin hole. Rough edges can damage the o-ring seal in the shifter housing.



1. Pin hole

4. Lightly coat the detent ball and spring with *Needle Bearing* grease.
5. Insert the spring in the housing, then the ball.

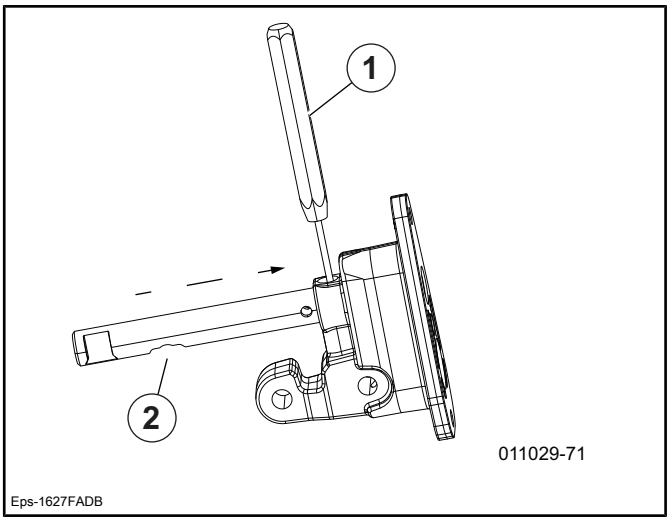


1. Spring
2. Ball

⚠ WARNING

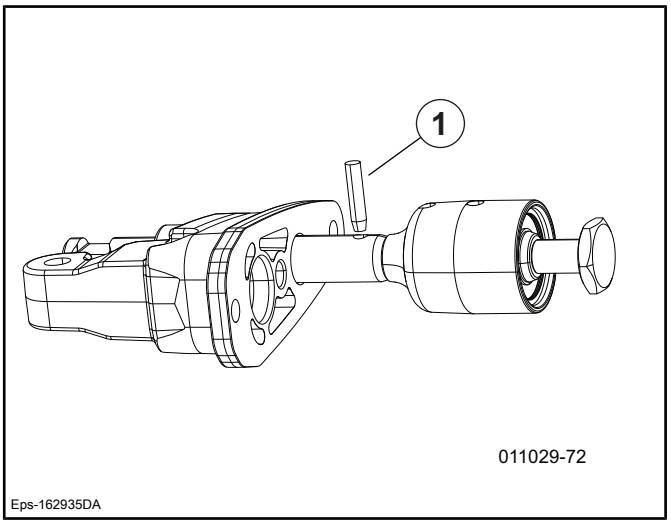
Wear safety glasses to avoid personal injury. The detent ball and spring and come out with great force.

6. Depress the ball and spring with a suitable tool, such as a small punch. Then install the detent shaft in the direction shown, past the ball and remove the tool.
7. Orient the NEUTRAL detent at as shown, install the detent shaft until the detent contacts the ball.



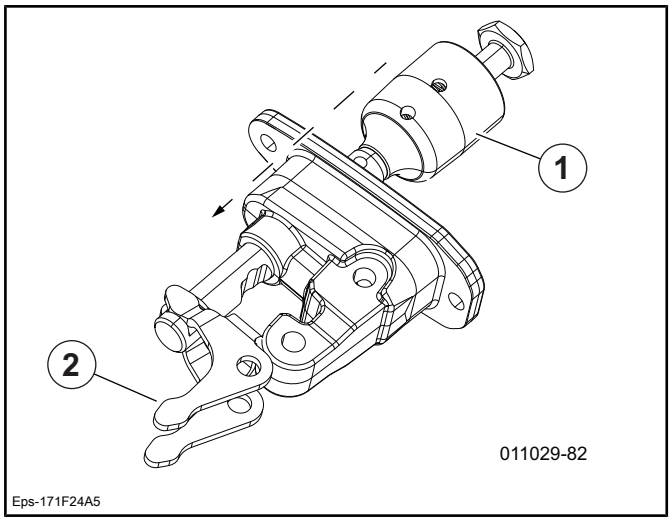
1. Punch
2. NEUTRAL detent

8. Install the detent assembly into the detent shaft, aligning the hole for the pin. Install the tapered end of the pin into the assembly. Use a brass drift pin to with a small hammer to tap the pin into place.



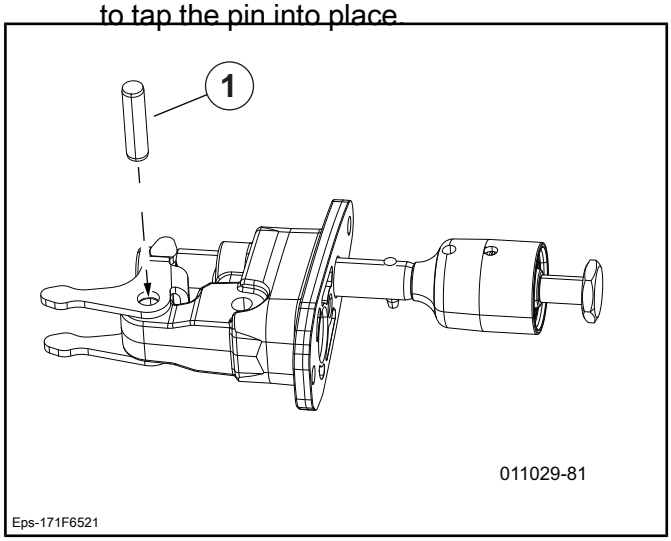
1. Pin

9. Install the shift lever onto the detent assembly and housing.
   1. Push the detent in the direction shown to put the assembly in the REVERSE position.
   2. Install arms of shift lever into detent slots.
   3. Push the detent assembly with the shifter lever to engage the NEUTRAL detent.



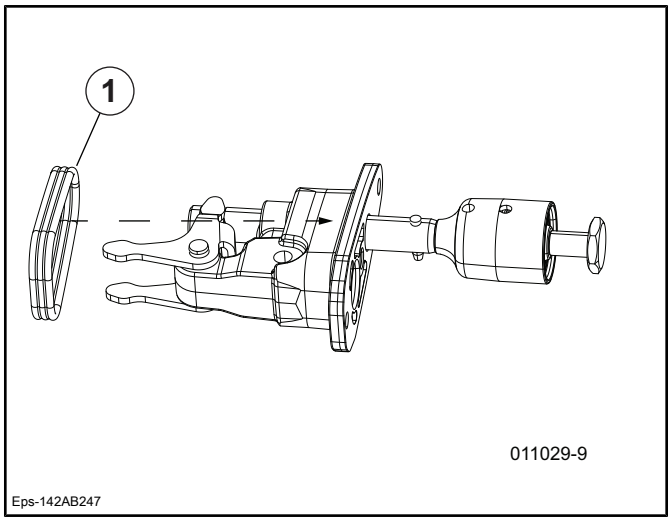
i. Detent assembly
ii. Shifter lever

10. Apply gearcase lubricant to the pin and pivot hole of the shifter housing.
11. Align the pivot holes in the housing and shift lever, then insert the retaining pin.
    1. Use a brass drift pin with a small hammer to tap the pin into place.



1. Pin

12. Apply *Triple Guard* grease to a new seal
13. Install the seal on the housing.



1. Seal

The oil tube and seal will be installed during gearcase assembly. Refer to **Gearcase Assembly**.

Drive Shaft Service

Manifold Housing Service

The driveshaft bearing is not serviceable. Replace the bearing housing assembly if the bearing is worn or damaged. Also, inspect the driveshaft bearing surface if the bearing is damaged.

Seal Removal

1. Remove the driveshaft bearing housing seals using Puller Bridge, P/N 432127, and Large Puller Jaws, P/N 432129. Discard the seals.

Required Tools
Puller Bridge **P/N 432127**
Large Puller Jaws **P/N 432129**

Eps-2A3860A2

1. *Puller bridge, P/N 432127*
2. *Large puller jaws, P/N 432129*

2. Remove and discard the O-ring and seal from the manifold.
3. Clean the manifold in solvent to remove old gasket sealing compound.

Seal Installation

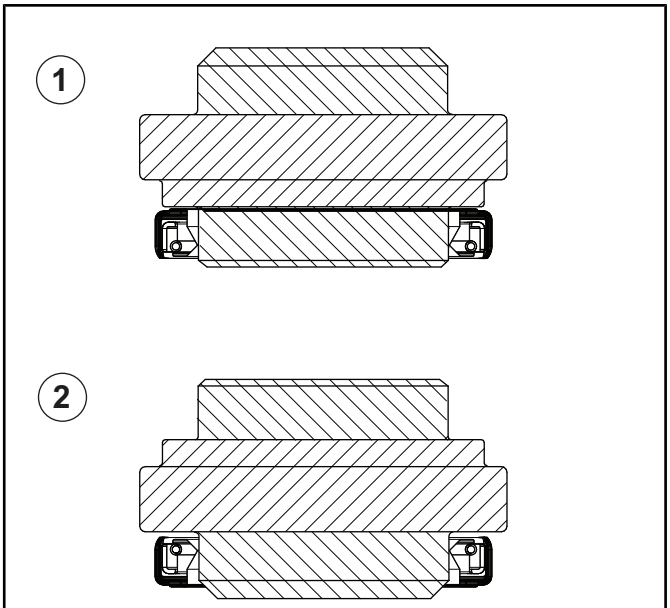
1. Make sure the manifold housing is clean and no old gasket sealing compound is in the seal bore.

Required Chemical
Gasket Sealing Compound **P/N 508235**

2. Apply *Gasket Sealing Compound* to metal castings of new seals before installing.

Required Tools
Seal Installer **P/N 330268**

3. Use Seal Installation Tool, P/N 330268, to install new seals back to back in bearing housing.



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SEAL INSTALLER, P/N 330268

1. *Inner seal*
2. *Outer seal*

4. Install the inner seal first with the lip of the seal facing toward the manifold. Then the outer seal with lip facing away from the manifold.
5. Press each seal into the manifold.

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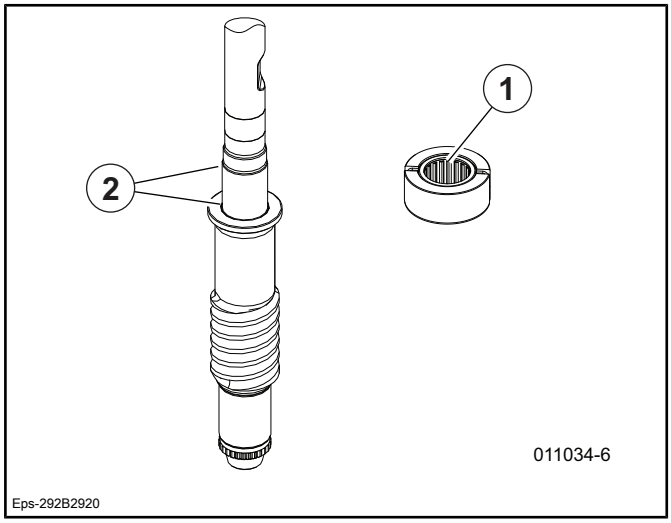
PRESS SEALS INTO MANIFOLD

Required Chemical
Triple Guard Grease **P/N 508298**

6. Apply *Triple-Guard grease* to seal lips.

Driveshaft Bearing

1. The driveshaft bearing is not serviceable. Inspect the bearing for wear or damage. Replace the bearing housing assembly if the bearing is worn or damage is found. Also, inspect the driveshaft bearing surface if the bearing is damaged.



1. Bearing
2. Inspect here

Driveshaft Shimming

NOTICE

If a new pinion gear is needed, replace gear set before shimming.

Pinion gear backlash is achieved by using shims between the driveshaft bearing housing and the thrust washer. When installing a new thrust bearing or washer, bearing housing, pinion gear, or driveshaft, it is necessary to properly shim the assembly to restore factory clearance.

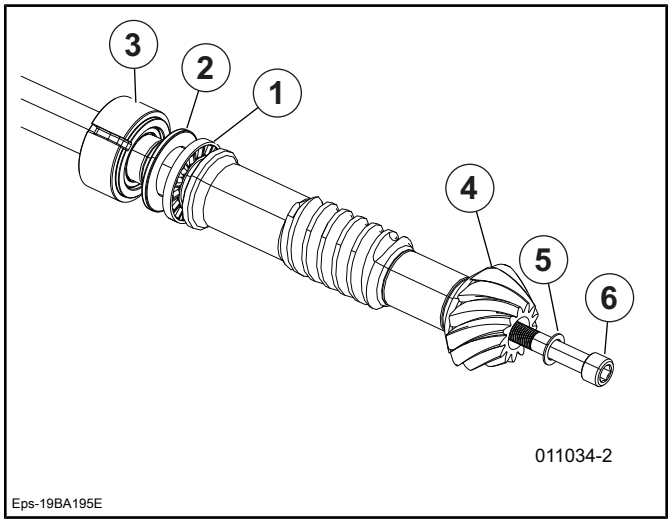
1. Use Driveshaft Shimming Tool, P/N 5005925, with the specified collar and shim gauge bar.

Required Tools
Driveshaft Shimming Tool **P/N 5005925**
Collar **P/N 362883**
Shim Gauge Bar **P/N 362882**

Shim gauge bars are precision made and MUST be handled carefully. The length of each bar is stamped near the part number. This dimension is 0.020 in (0.508 mm) shorter than the actual shimmed length of the driveshaft.

IMPORTANT: Clean pinion and driveshaft before assembly. Replace any damaged parts.

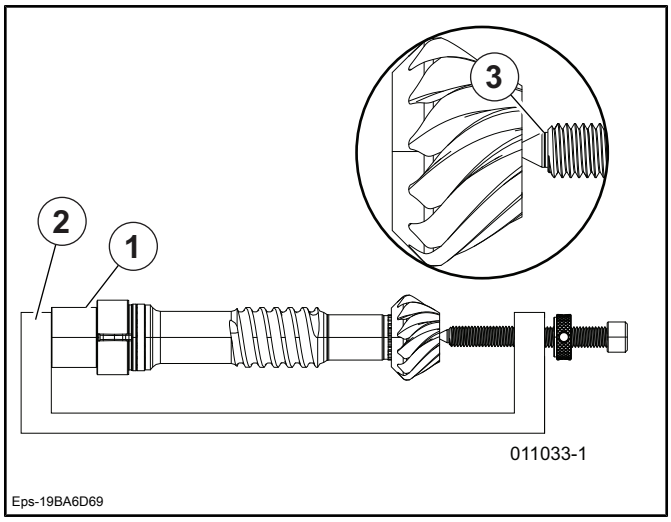
2. Install the thrust bearing, thrust washer, and driveshaft bearing housing, onto the driveshaft.
3. Install the pinion gear onto the driveshaft.
4. Lightly coat the washer and threads of the pinion screw with gearcase lubricant and tighten to a torque of 30 to 33 Ft. lbs. (22.1 to 24.3 N·m).



1. Thrust bearing
2. Thrust washer
3. Driveshaft bearing housing
4. Pinion gear
5. Washer
6. Screw

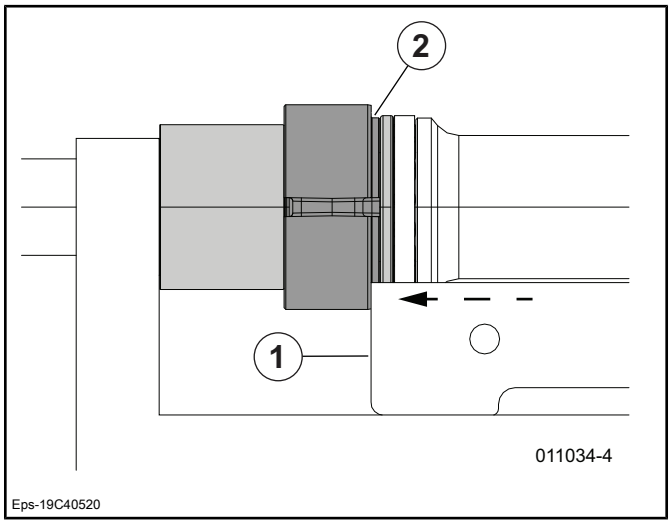
IMPORTANT: The original pinion screw and washer may be used for shimming, but must NOT be used in final assembly.

5. Install collar, P/N 362883, onto the driveshaft assembly, with the large end in contact with the bearing housing.
6. Insert the assembled driveshaft into the driveshaft shimming tool and tighten preload screw against the driveshaft until groove on the spring-loaded plunger is flush with end of threads.
7. Tighten locking ring on pre-load screw.



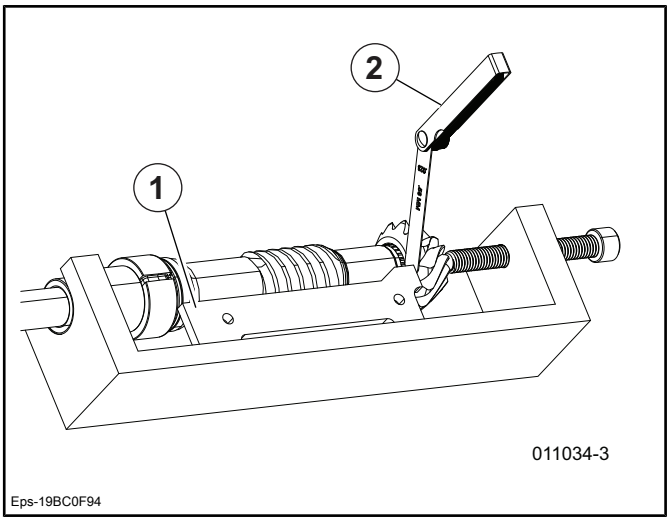
1. Collar, P/N 362883
2. Driveshaft shimming tool
3. Groove

8. Rotate the driveshaft several revolutions to seat bearings.
9. Lay the tool base on its side and position the shim Gauge Bar, P/N 362882, against guide pins of the tool base.
10. Check squareness of the pinion to the driveshaft.
11. Hold the shim gauge bar against the bearing housing while rotating just the driveshaft and pinion assembly.



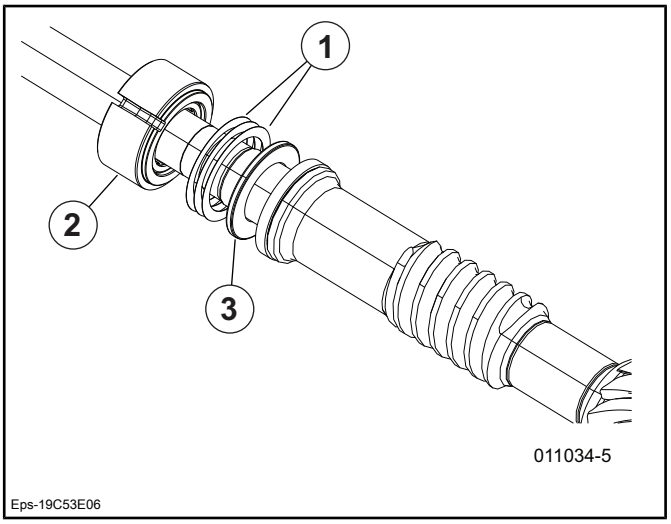
1. Shim gauge bar
2. Bearing housing

12. Measure clearance between the gauge bar and the pinion at several locations.



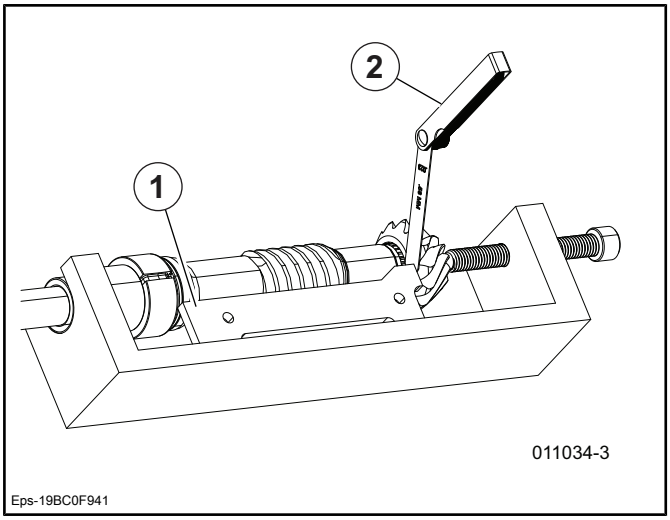
1. Gauge bar, P/N 362882
2. Feeler gauge

13. If variance is greater than 0.002 in. (0.050 mm) replace the pinion or driveshaft, as necessary, and repeat check.
14. Subtract the average clearance measurement from 0.020 in. (0.508 mm) to determine the correct shim thickness required. Select the fewest number of shims to achieve the correct thickness.
15. Remove the driveshaft from the driveshaft shimming tool.
16. Add the required shims between the bearing housing and the thrust washer.



1. Shims
2. Bearing housing
3. Thrust washer

17. Reinstall the driveshaft assembly with the added shims into the driveshaft shimming tool.
18. Check the clearance again.



1. *Gauge bar, P/N 362882*
2. *Feeler gauge*

The measurement between the gauge bar and pinion gear should be 0.020 in. (0.508 mm).

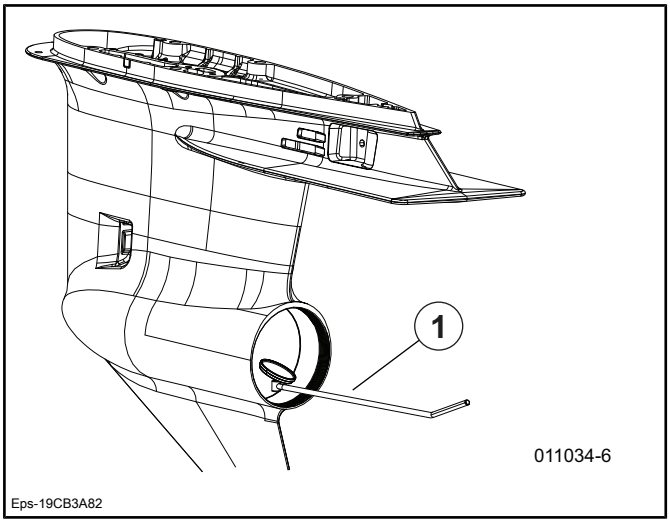
19. Remove the driveshaft assembly from the tool.
20. Remove the screw and washer from the pinion gear. Remove the pinon gear from the driveshaft and discard the screw and washer.

Pinion Bearing Service

Pinion Bearing Removal

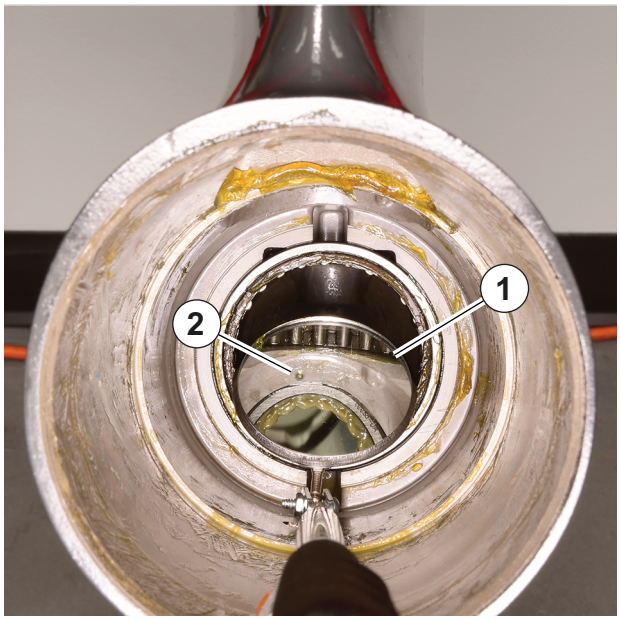
The pinion bearing for SLX-2 gearcase is installed and “staked” into place at the factory. Inspect the pinion bearing staking marks, as follows, BEFORE removing the bearing.

1. Use an inspection mirror to inspect the pinion bearing staking marks in the gearcase housing.



1. *Inspection mirror*

   – A factory staking tool compresses the material around the bore of the pinion bearing in three places.
   – This is done to retain the bearing in its designed location.
2. Determine how many staking marks are located around the pinion bearing bore.

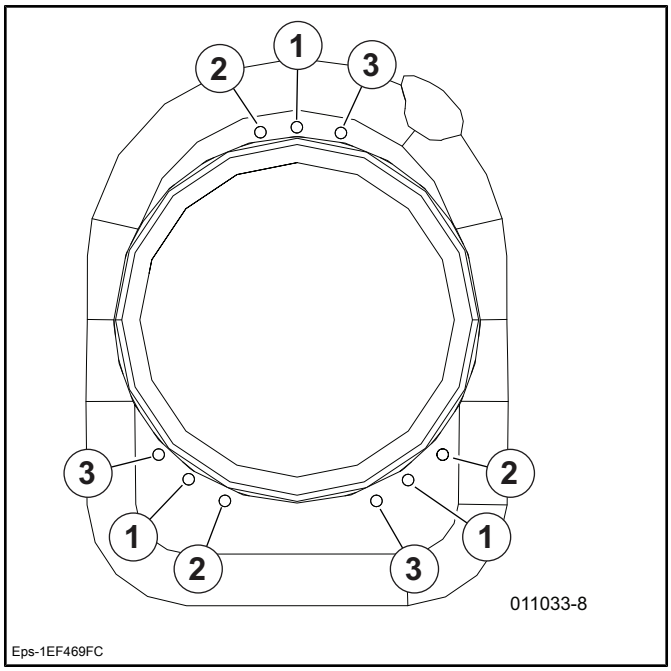


1. *Inspection mirror*
2. *Forward staking mark*

   – One set of three staking marks indicates the pinion bearing installation from the factory.
   – A second set of three staking marks indicates the pinion bearing has been replaced one time.
   – A third set of three staking marks indicates the pinion bearing has been replaced two times.

NOTICE

The gearcase housing MUST be replaced if three sets of staking marks are found in the gearcase housing AND the pinion bearing requires replacement a THIRD time. Failure to replace the gearcase housing when replacing the pinion bearing for the third time will result in pinion bearing failure.



1. Original staking locations
2. Service tool staking location (1st replacement)
3. Service tool staking location (2nd replacement)

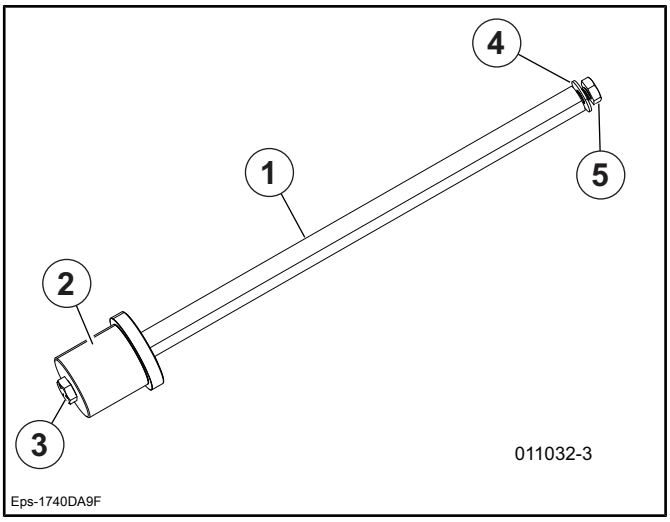
3. Remove the pinion bearing only if it needs to be replaced.

Required Tool
Pinion Bearing Remover and Installer
P/N 5005927

4. Assemble the following components of the Pinion Bearing Remover and Installer, P/N 5005927, as follows.

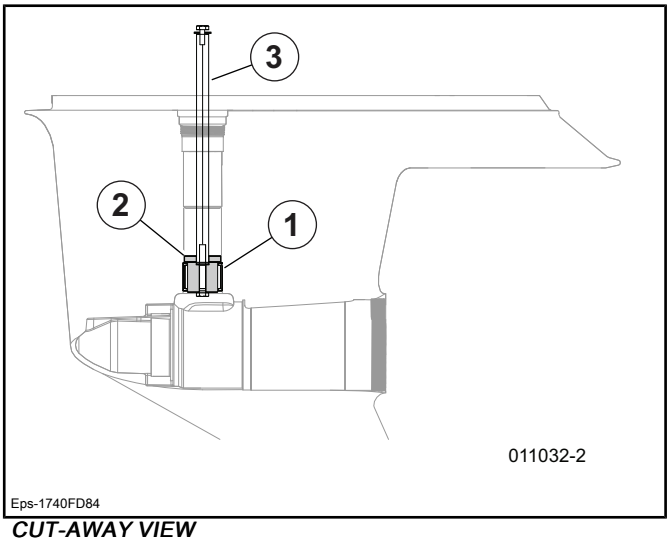
   · Rod, P/N 326582, with 1 in. O.D. flat washer and 1/4–20 x.0.5 in. hex head screw

   · Remover /Installer, P/N 326574, with 1/4–20 x 2.25 in. hex head screw



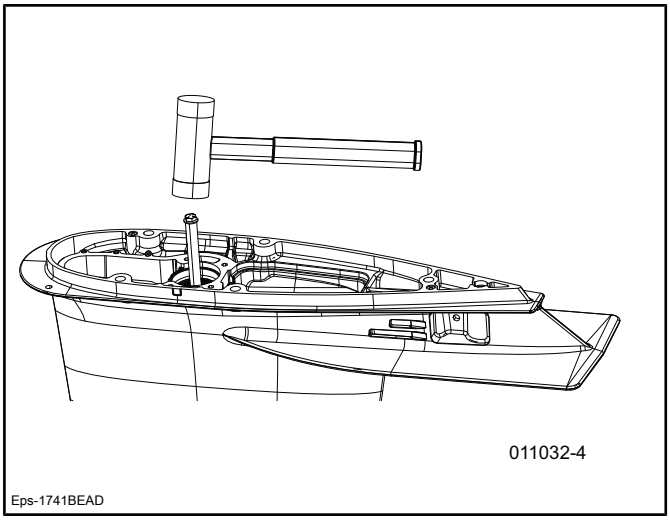
1. Rod, P/N 326582
2. Remover /Installer, P/N 326574
3. Screw (long)
4. Washer
5. Screw (short)

5. Ensure all 18 of the needles are installed inside the bearing race. The needles provide a surface for the remover to push against.
6. Insert the assembled tool through the top of the gearcase housing and into the bearing as shown.



CUT-AWAY VIEW
1. Bearing
2. Remover/Installer
3. Rod

7. Tap the end of the rod with a mallet to drive the bearing DOWN, into the gearcase housing.



8. Remove the bearing, bearing needles and tool from the gearcase housing.

Pinion Bearing Installation

The pinion bearing is installed and staked into the gearcase housing in three places. The service tool allows the pinion bearing to be replaced up to two times.

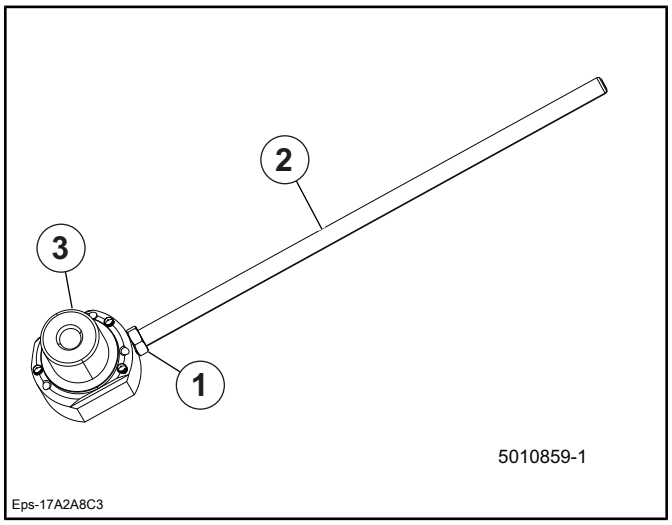
NOTICE

The gearcase housing MUST be replaced if three sets of staking marks are found in the gearcase housing AND the pinion bearing requires replacement a THIRD time. Failure to replace the gearcase housing when replacing the pinion bearing for the third time will result in pinion bearing failure.

1. Review this procedure COMPLETELY and obtain the required tools BEFORE attempting pinon bearing installation.

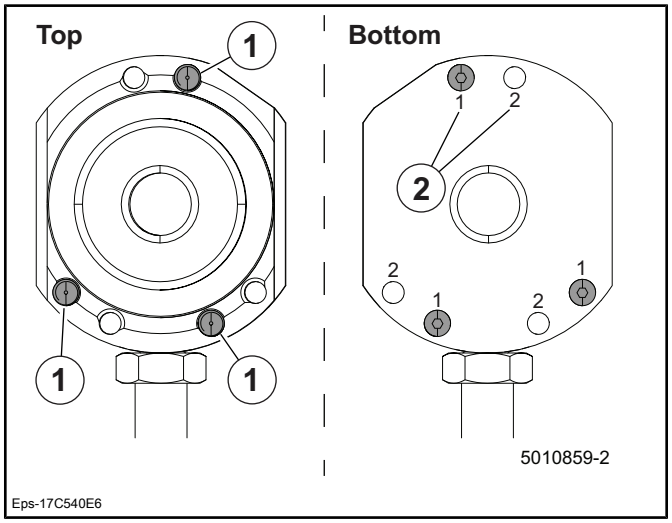
Required Tools
Pinion Bearing Staking Tool Kit **P/N 5010859**
Bearing Housing Tool **P/N 358520**
Alignment Fixture **P/N 360844**

2. Assemble the locking nut, handle and base of the Pinion Bearing Staking Tool Kit, P/N 5010859, as shown. After installing the handle and locking nut, tighten the nut securely against the base of the tool.



1. *Locking nut*
2. *Handle*
3. *Base*

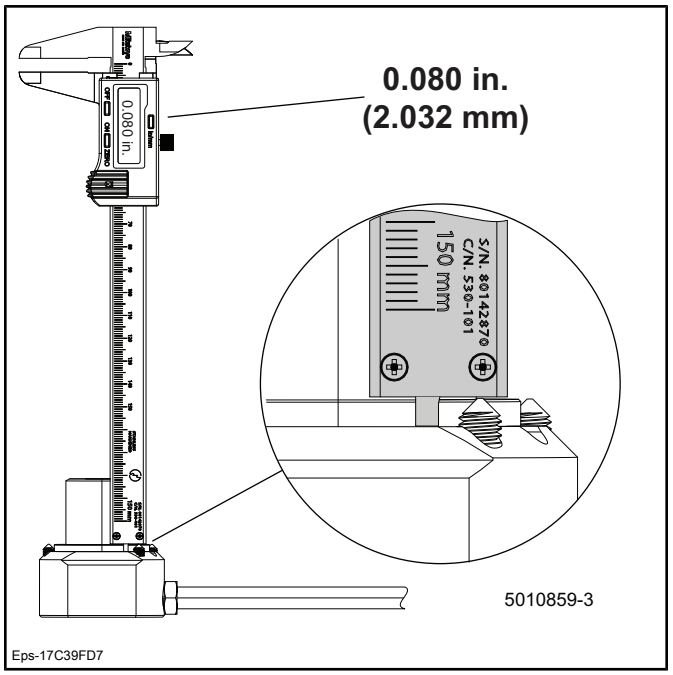
IMPORTANT: If replacing bearing for the first time, make SURE the pins are located in hole "**1**". If bearing has been previously replaced, make SURE the pins are located in hole "**2**". Hole locations are stamped on the bottom of the tool base.



1. *Pins*
2. *Hole locations*

3. Use digital calipers to check the height of each pin.

   Pin height MUST be 0.080 in. (2.032 mm).
   1. Insert a 3/32 in. (0.8 mm) hex key in the bottom of each pin to adjust the pin height.
   2. Turn the hex key counter-clockwise to lower the pin, or clockwise to raise the pin.



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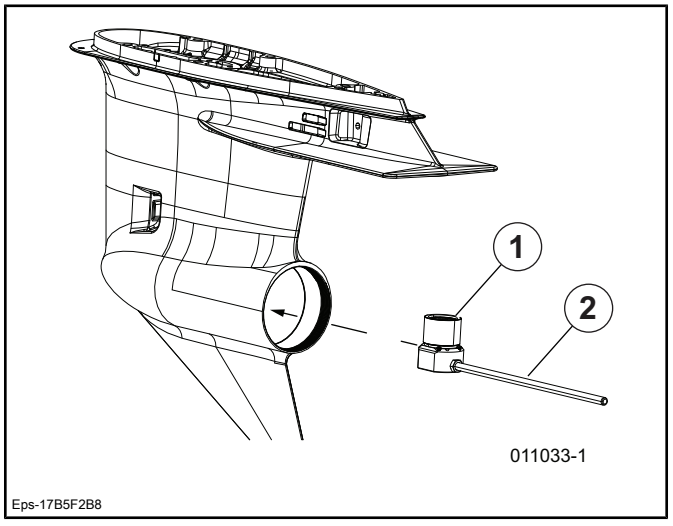
4. Apply *Needle Bearing* grease to the needle bearings and insert them into the bearing race.
5. Place the bearing on the staking tool with the lettered side of the bearing facing the base of the tool.
6. Liberally apply gearcase lubricant to the outside of the bearing race and to the bore for the pinion bearing inside the gearcase housing.
7. Insert the staking tool with the bearing into the gearcase.



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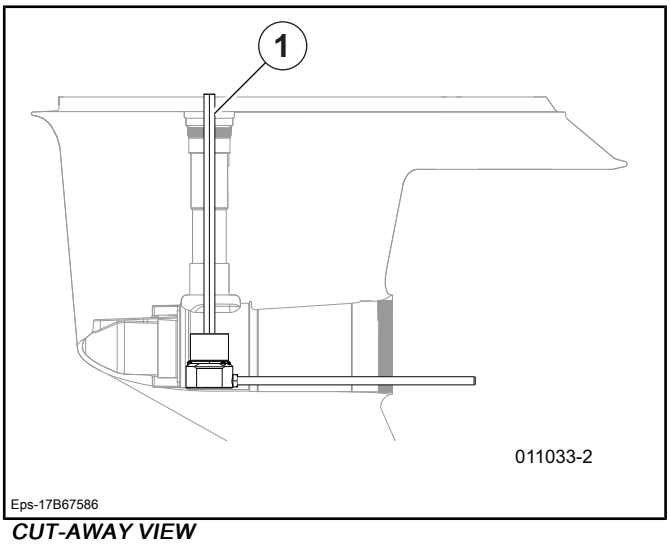
1. Pinion bearing
2. Staking tool

8. Insert the threaded rod from Bearing Housing Tool, P/N 358520, into the gearcase housing and thread it completely into the staking tool.

   If Bearing Housing Tool, P/N 358520, is not available a length of 1/2–20 threaded rod at least 12 in (305 mm) long can be used.



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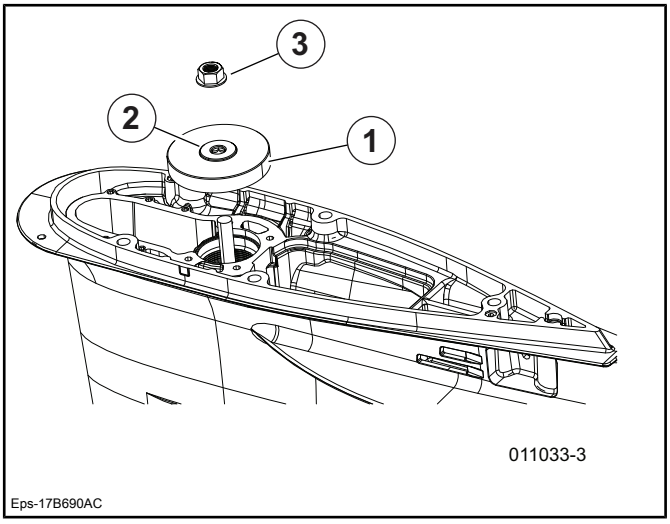
CUT-AWAY VIEW
1. Threaded rod

9. Install the pilot plate, P/N 361598, over the threaded rod (thrust bearing up). Then install the puller nut from Bearing Housing Tool, P/N 358520, on the threaded rod.

   If Bearing Housing Tool, P/N 358520, is not available a 1/2–20 nut with a flat washer can be used.



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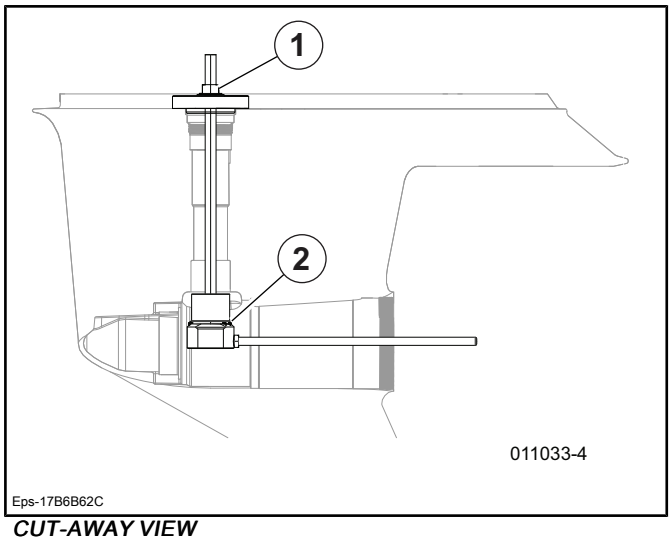
1. Pilot plate, P/N 361598
2. Thrust bearing
3. Nut

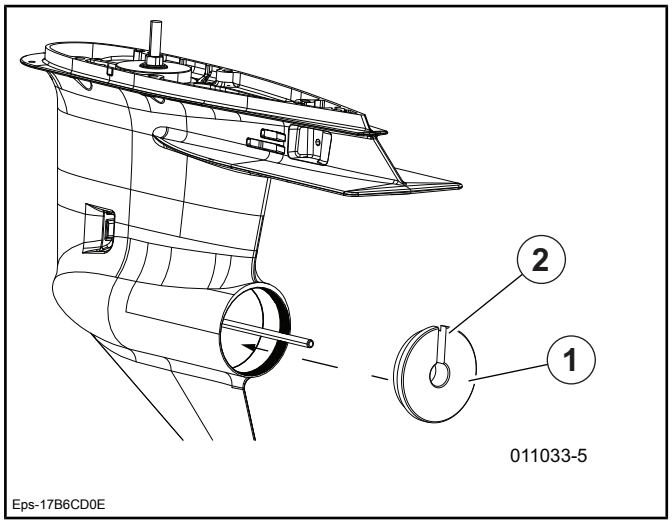
10. Align the pilot plate with the opening for the drive shaft and hand tighten the nut until the bearing contacts the gearcase housing.



CUT-AWAY VIEW
1. Nut
2. Pinion bearing and tool

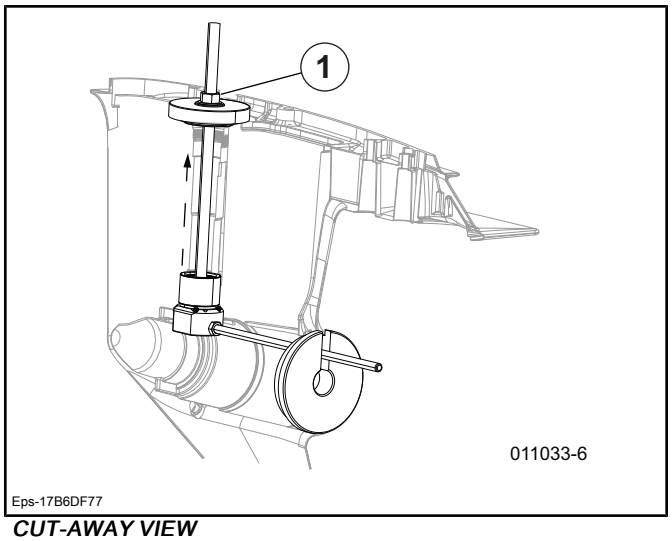
11. Place Alignment Fixture, P/N 360844, over the back of the gearcase housing, with the slot oriented as shown.

    The slot will guide the handle of the staking tool as the bearing is pulled into place.



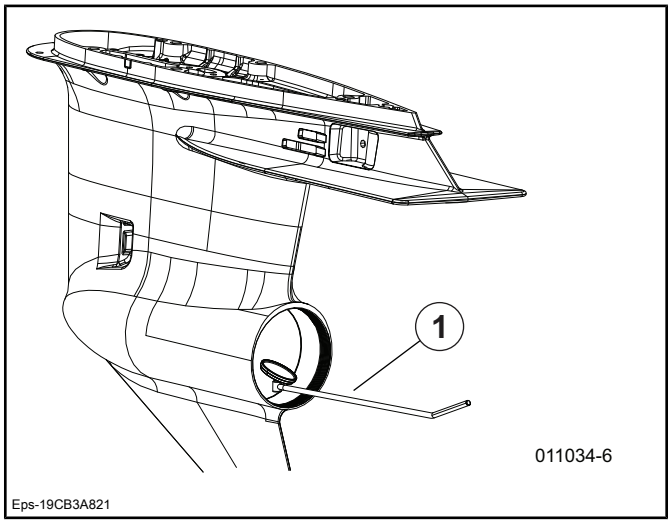
1. Alignment fixture, P/N 360844
2. Slot

12. Use a torque wrench to tighten the puller nut to a torque of 40 ft. lbs. (54.23 N·m).



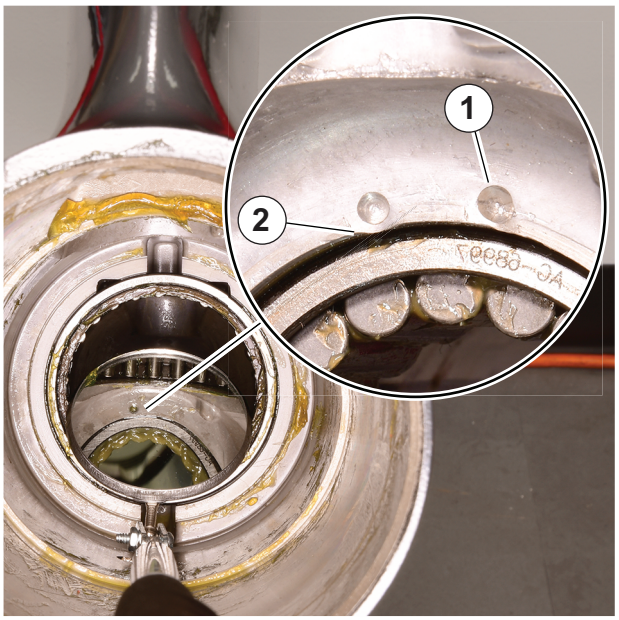
CUT-AWAY VIEW
1. Nut

13. Remove the nut, pilot plate and threaded rod from the staking tool and gearcase housing. Then remove the staking tool and alignment fixture.
14. Use an inspection mirror to confirm bearing is fully installed and pinion bearing has been adequately staked to the gearcase housing in three places.



1. Inspection mirror

15. Inspect all three staking locations. ENSURE material has been compressed around the bore of the pinion bearing.



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1. *Original staking mark*
2. *New staking mark*

Gearcase Assembly

SERVICE TOOLS

Description	Part Number	Page
ALIGNMENT FIXTURE	P/N 360844	369, 374
BACKING PLATE	P/N 325867	344
BEARING HOUSING TOOL	P/N 358520	369
BEARING INSTALLER	P/N 360315	352, 374
BEARING INSTALLER	P/N 362024	349
COLLAR	P/N 362883	365
DRIVE HANDLE	P/N 311880	374
DRIVESHAFT PULLER	P/N 390706	344
DRIVESHAFT SHIMMING TOOL	P/N 5005925	365
EXTRA LARGE PULLER JAWS	P/N 360849	345, 350
GEARCASE PRESSURE TESTER	P/N 507977	321
GEARCASE VACUUM TESTER	P/N 507982	322
HANDLE	P/N 345822	378
LARGE PULLER JAWS	P/N 432129	349, 363
PINION BEARING REMOVER AND INSTALLER	P/N 5005927	368
PINION BEARING STAKING TOOL KIT	P/N 5010859	369
PROPELLER SHAFT ASSEMBLY INSTALLER	P/N 360847	378
PULLER BRIDGE	P/N 360312	350
PULLER BRIDGE	P/N 432127	347, 349, 363
PULLER JAWS	P/N 432131	347
PULLER PLATE	P/N 360314	350
PULLER PLATE	P/N 363152	345
PULLER SHAFT AND NUT	P/N 360313	345, 350
SEAL INSTALLER	P/N 330268	364
SEAL INSTALLER	P/N 362025	347
SEAL PROTECTOR	P/N 318674	382
SHIFT ROD INSTALLER/REMOVER	P/N 358162	380
SHIFT ROD INSTALLER	P/N 358162	332
SHIM GAUGE BAR	P/N 362882	365
SPANNER NUT SOCKET	P/N 360842	376
SPANNER NUT WRENCH	P/N 360054	340, 379
WIDE PULLER JAWS	P/N 391012	345, 350
WRENCH	P/N 360843	376

SERVICE PRODUCTS

Description	Part Number	Page
ADHESIVE 847	P/N 776964	328
GASKET SEALING COMPOUND	P/N 508235	329–330, 347, 364
GEARCASE LUBRICANT (HPF PRO)	P/N 508298	356–357
GEARCASE LUBRICANT (HPF PRO)	P/N 778755	374, 376
LOCTITE 648 (OBTAIN LOCALLY)		375
MOLY LUBE	P/N 768306	325
NEEDLE BEARING GREASE	P/N 378642	375, 380
NEEDLE BEARING GREASE	P/N 508298	377
TRIPLE GUARD GREASE	P/N 508298	328
TRIPLE GUARD GREASE	P/N 508298	328–329, 347, 364, 377, 380–381
ULTRA LOCK (RED)	P/N 500422	382

Front Bearing and Gear Installation

1. Rotate the fixture holding the gearcase housing, so the back of the gearcase housing is UP.

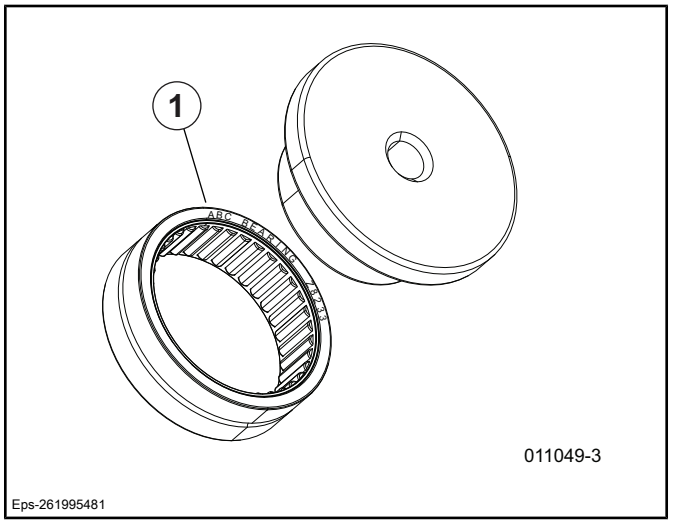
Required Tools
Bearing Installer
P/N 360315
Drive Handle
P/N 311880
Alignment Fixture
P/N 360844

2. Assemble Bearing Installer, P/N 360315, onto Drive Handle, P/N 311880.

Required Chemical
Gearcase Lubricant (HPF Pro)
P/N 778755

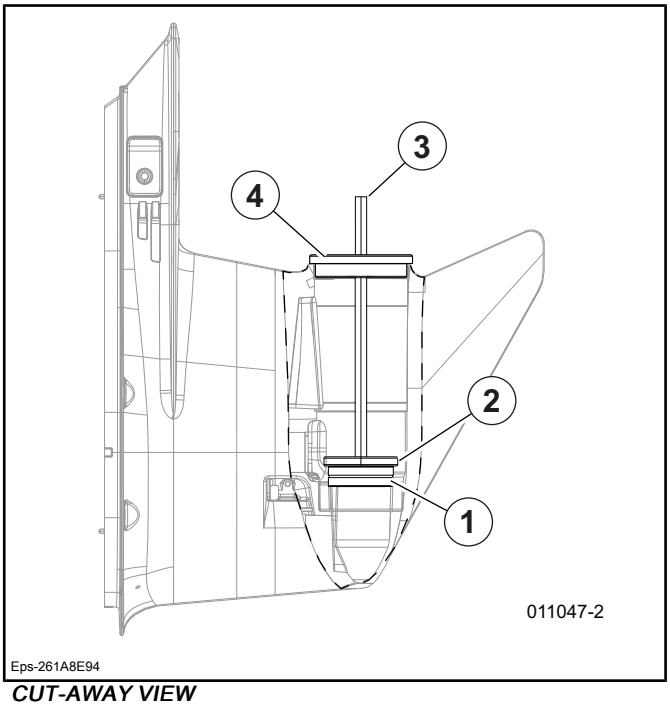
3. Apply gearcase lubricant to the bearing needles and to the outside of the bearing case. Then install the bearing in bearing housing as follows.
4. Place the lettered end of the bearing case on the bearing installer.

IMPORTANT: When installed, the lettered end of the bearing should be visible.



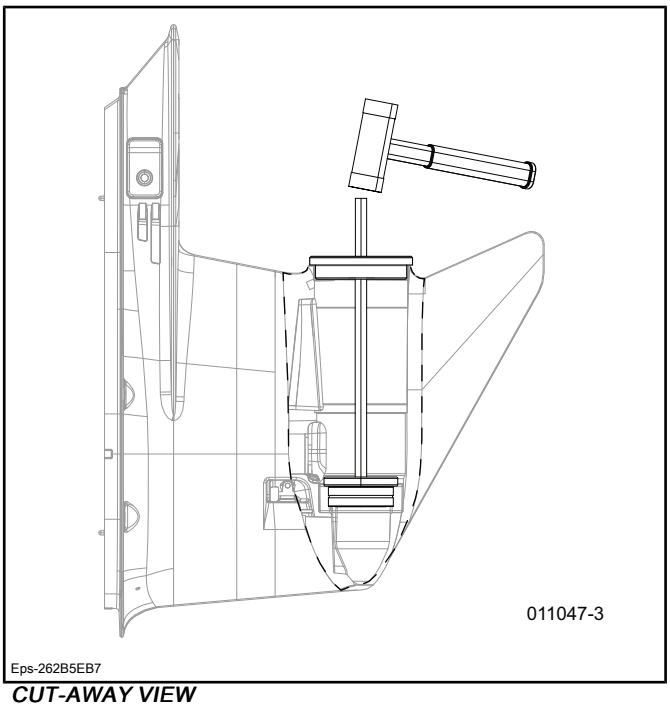
1. Lettered side of bearing

5. Place the bearing and installer tools into the gearcase housing, aligning the bearing with the bearing bore.
6. Place Alignment Fixture, P/N 360884 over the gearcase housing and drive handle as shown.



CUT-AWAY VIEW
1. Front bearing
2. Bearing installer, P/N 360315
3. Drive handle, P/N 311880
4. Alignment fixture, P/N 360844

7. Tap the drive handle with a mallet until the front bearing is seated in the gearcase housing.

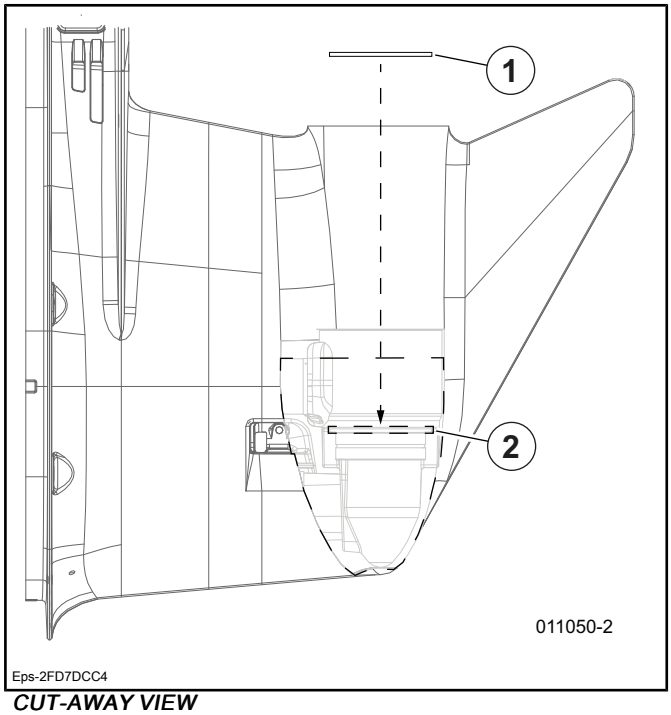


CUT-AWAY VIEW

8. Remove the bearing installer and drive handle from the gearcase.

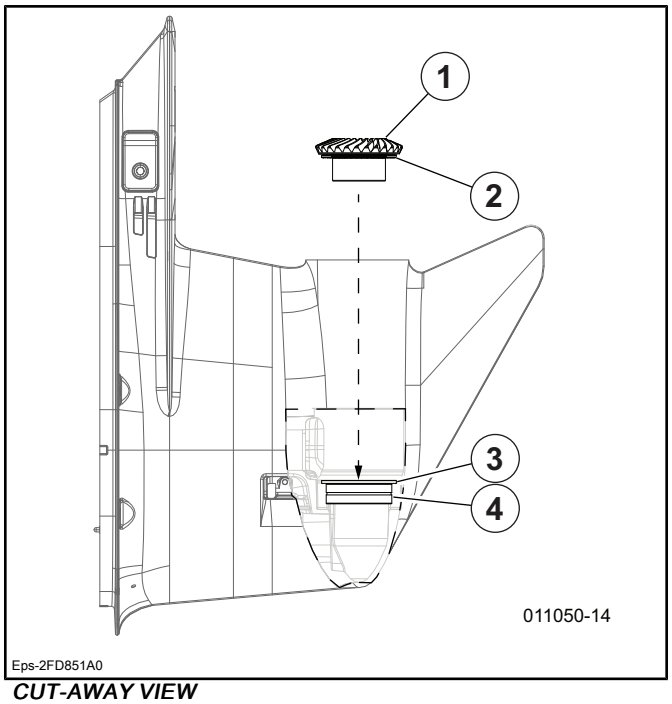
Required Chemical
Needle Bearing Grease **P/N 378642**

9. Apply Needle Bearing Grease, P/N 378642, to the thrust washer. Install the thrust washer into the gearcase, ensuring it is seated in the recess of the gearcase housing.



CUT-AWAY VIEW
1. Thrust washer
2. Recess

10. Apply Needle Bearing Grease, P/N 378642, to the thrust bearing and place the bearing onto the gear assembly.
11. Install the gear assembly and thrust bearing into the thrust washer and forward bearing.



CUT-AWAY VIEW
1. Gear assembly
2. Thrust bearing
3. Thrust washer
4. Forward bearing

12. Rotate the fixture holding the gearcase housing, so the propeller shaft is parallel to the floor when installed.

Pinion Gear and Driveshaft Installation

Correct pinion gear backlash MUST be confirmed BEFORE installing the pinion gear and driveshaft, when a new thrust bearing, thrust washer, bearing housing, pinion gear, or driveshaft is being installed. Refer to **Driveshaft Shimming**.

IMPORTANT: The inside taper of the pinion gear and the driveshaft taper MUST be completely free of grease.

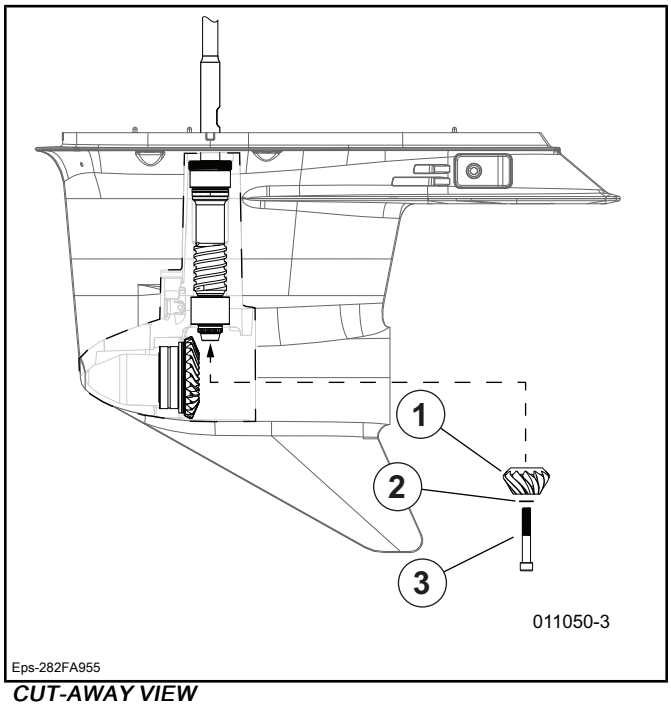
1. Clean the pinion gear taper of the driveshaft with solvent and dry with a clean lint-free shop towel.

Required Chemical
Loctite 648 (obtain locally)

2. Apply *Loctite 648* to the pinion gear taper of the driveshaft.
3. Place the driveshaft into the gearcase housing. Use care to not get oil or grease on the pinion gear taper.
4. Clean the taper of the pinion gear with solvent and dry with a clean lint-free shop towel.

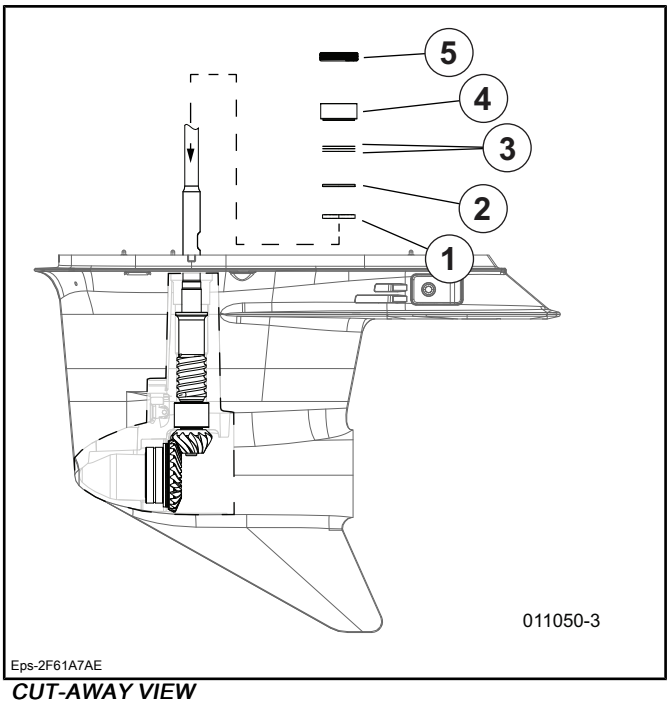
Required Chemical
Gearcase Lubricant (HPF Pro) P/N 778755

5. Lightly apply gearcase lubricant to the washer and to the threads only of the pinion gear screw.
6. Install the pinion gear on the driveshaft. It will be necessary to lift the driveshaft slightly, to install the pinion gear.
7. Place the washer on the screw and install the screw into the pinion gear and driveshaft. Do NOT tighten the screw at this time.



CUT-AWAY VIEW
1. Pinion gear
2. Washer
3. Screw

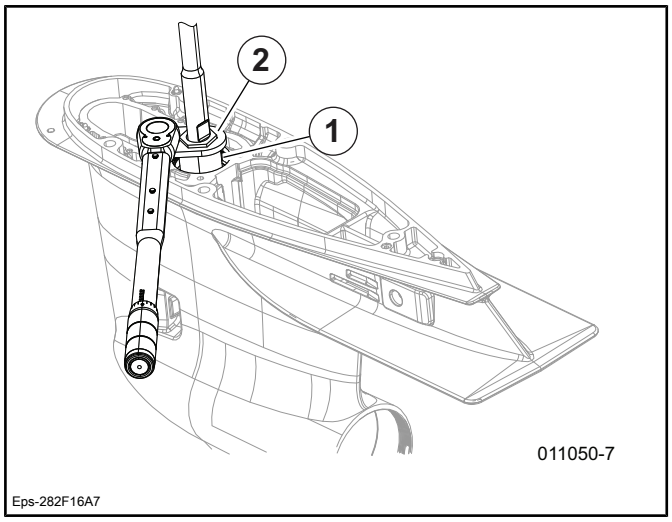
8. Install the thrust bearing, thrust washer, shims, driveshaft bearing assembly and spanner nut.



CUT-AWAY VIEW
1. Thrust bearing
2. Thrust washer
3. Shims
4. Driveshaft bearing assembly
5. Spanner nut

Required Tools
Spanner Nut Socket P/N 360842
Wrench P/N 360843

9. Use Spanner Nut Socket, P/N 360842, to install the spanner nut by hand.
10. Use Wrench, P/N 360843, Spanner Nut Socket, P/N 360842, and a torque wrench to tighten the spanner nut to a torque of 63 to 67 Ft. Lbs. (85.4 to 90.8 N·m).



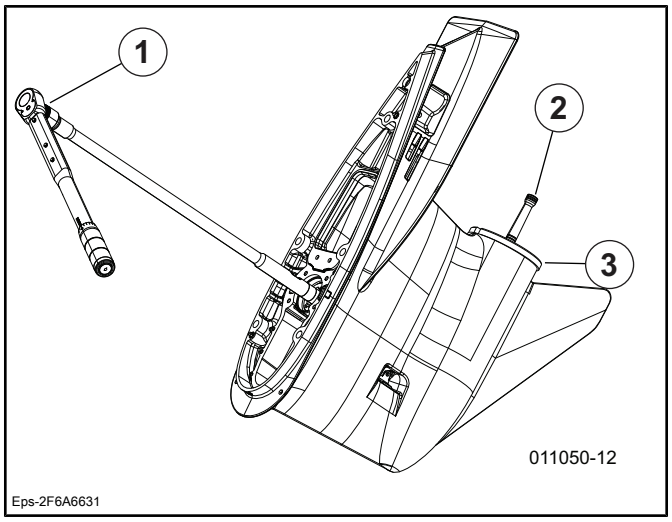
1. Spanner nut socket, P/N 360842
2. Wrench, P/N 360843

Required Tools
Driveshaft Spline Socket
P/N 311875
Alignment Fixture
P/N 360844

11. Use Driveshaft Spline Socket, P/N 311875, with a torque wrench and a 5/16 in. (8 mm) hex socket with a breaker bar to tighten the screw.

IMPORTANT: Make SURE the hex key of the hex socket is fully engaged with the hex on the pinion screw.

12. Place Alignment Fixture, P/N 360844, over the gearcase housing and handle of the breaker bar as shown. The alignment fixture will hold the handle of the breaker bar and prevent damage to the threads of the gearcase housing.



1. Driveshaft spline socket with torque wrench
2. Hex socket with breaker bar
3. Alignment fixture, P/N 360844

13. Tighten to a torque of 30 to 33 Ft. Lbs. (22.1 to 24.3 N·m).

Propeller Shaft Bearing Housing and Gear Installation

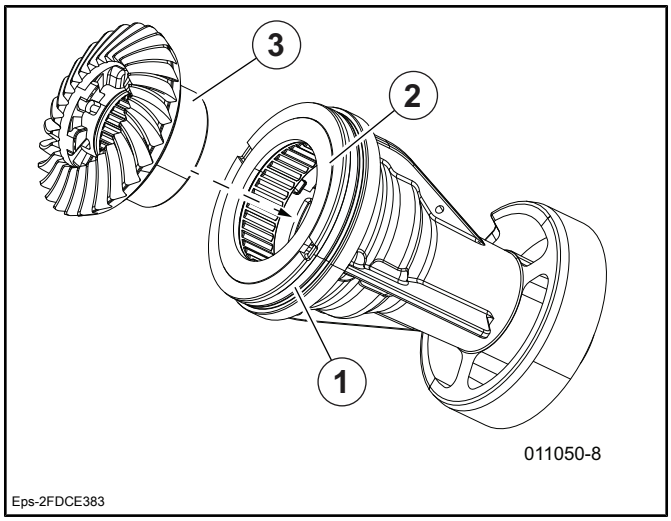
1. Assemble the propeller shaft bearing housing, gear assembly and propeller shaft as follows.

Required Chemical
Triple Guard Grease
P/N 508298

2. Apply *Triple Guard* grease to a new o-ring and install the o-ring on the bearing housing.

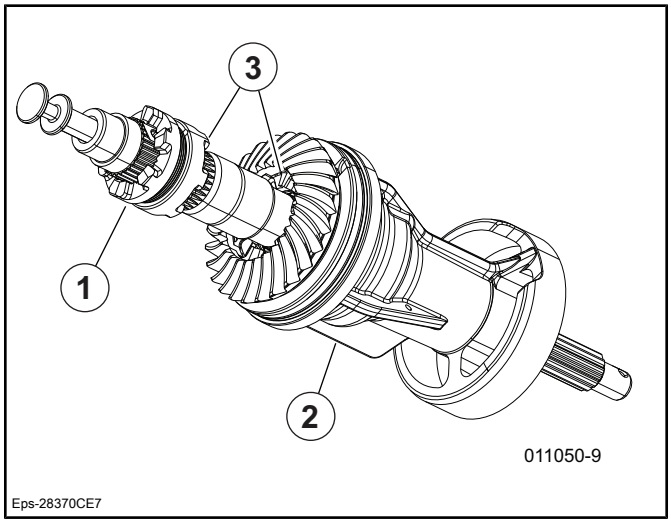
Required Chemical
Needle Bearing Grease
P/N 508298

3. Apply Needle Bearing Grease, P/N 378642, to the thrust washer. Install the thrust washer into the bearing housing, ensuring it is seated in the recess of the housing.
4. Apply Needle Bearing Grease, P/N 378642, to the thrust bearing and install the bearing onto the gear assembly.
5. Install the gear assembly, with the thrust bearing into the propeller shaft bearing housing.



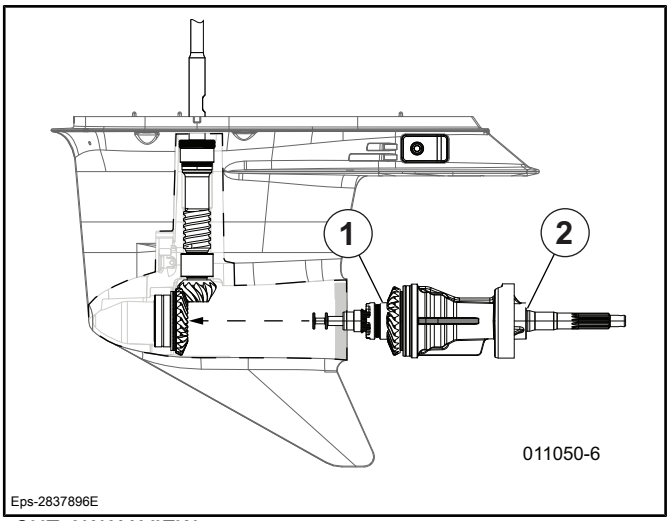
1. O-ring
2. Thrust washer
3. Gear assembly and thrust bearing

6. Install the propeller shaft assembly through the gear assembly, into the propeller shaft bearing housing.
7. To aid the next assembly steps, align the clutch dog with the gear so the clutch dog is lug-on-lug with the gear.



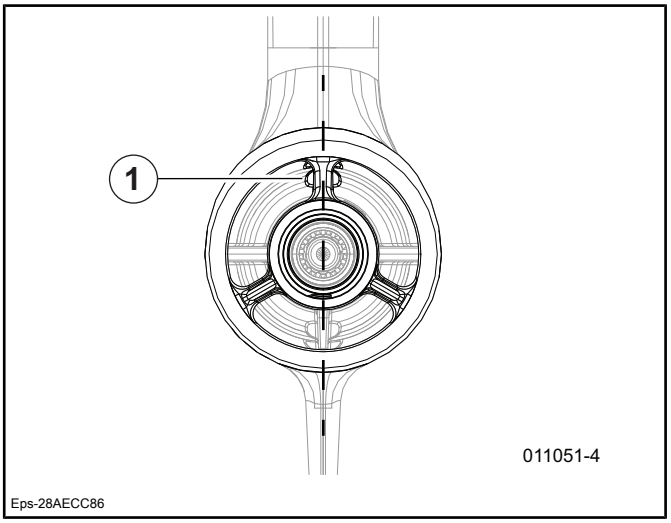
1. Propeller shaft assembly
2. Propeller shaft bearing housing
3. Clutch dog lug-on-lug with the gear

8. Make sure the clutch dog is lug-on-lug with the gear. This will help maintain the shifter shaft in the NEUTRAL position.
9. Hold the propeller shaft and bearing housing at the point shown below, to prevent either from rotating.
10. Install the assembly into the gearcase housing.



CUT-AWAY VIEW
1. Clutch dog lug-on-lug with the gear
2. Hold propeller shaft and bearing housing here

11. Rotate the fixture holding the gearcase housing, so the propeller shaft is vertical.
12. Make sure the upper support rib of the bearing housing is aligned as shown.

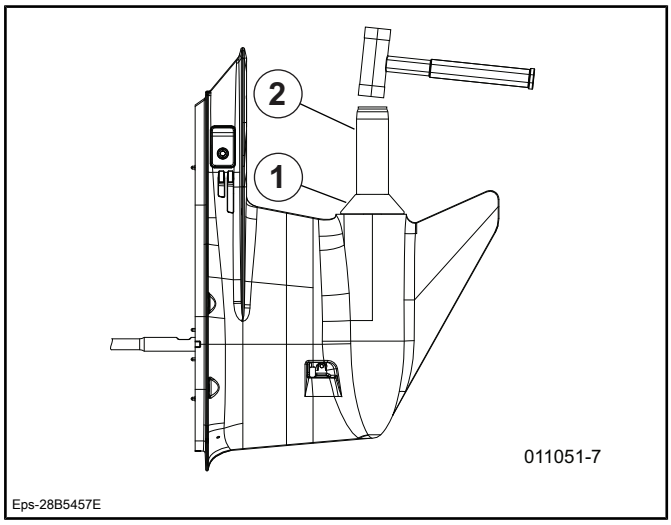


1. Rib

Required Tools
Propeller Shaft Assembly Installer **P/N 360847**
Handle **P/N 345822**

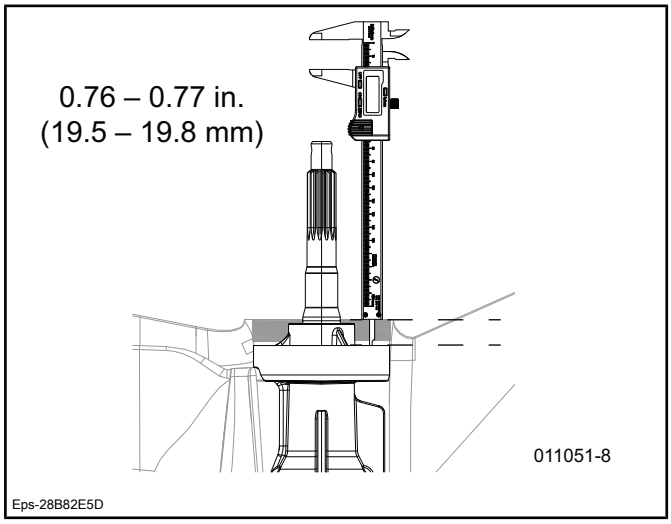
13. Place Propeller Shaft Assembly Installer, P/N 360847, over the propeller shaft.
14. Place the Handle, P/N 345822, on the installer.

15. Use a mallet to tap the bearing housing into place until seated.

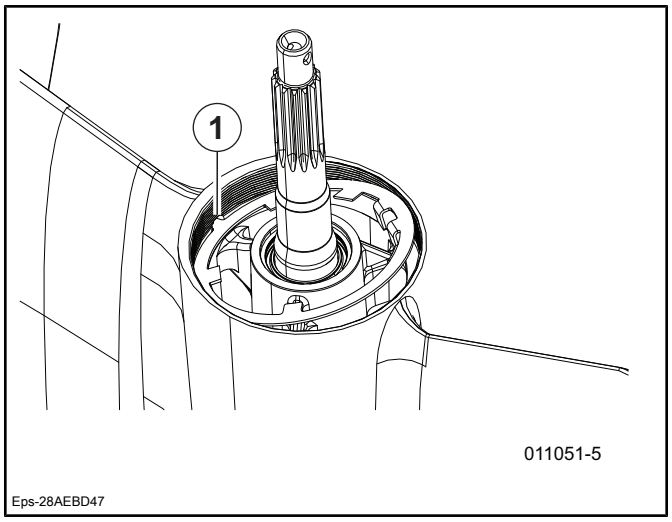


1. Propeller shaft assembly installer, P/N 360847
2. Handle, P/N 345822

16. Remove the installer and handle from the gearcase.
17. Use a caliper to check the depth of the bearing housing. The dimension from the back of the bearing housing to the outer edge of the gearcase housing should be 0.76 – 0.77 in. (19.5 – 19.8 mm).

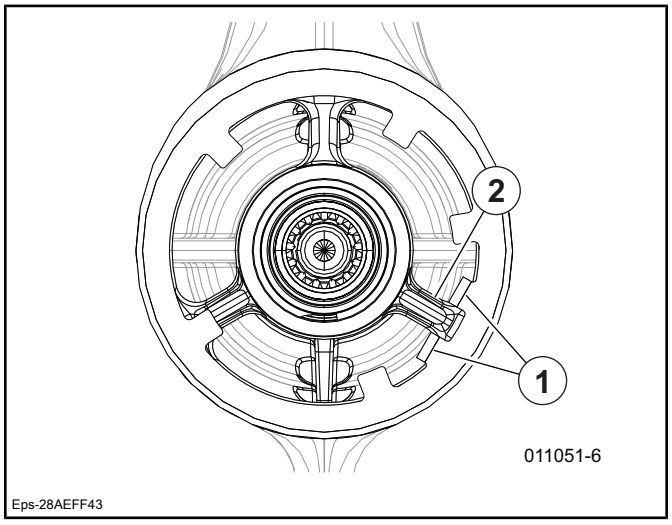


18. Install a new locking ring with the alignment tab in the hole at the top of the housing.



1. Locking ring alignment tab

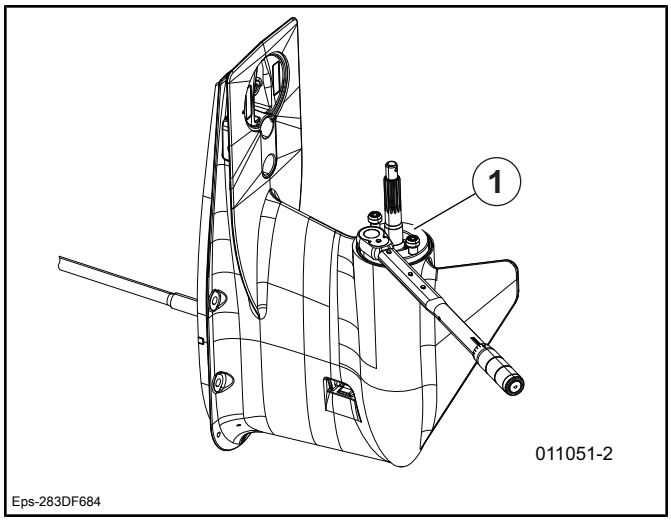
19. Ensure the locking ring is flat against the bearing housing and the two tabs are positioned over the lower support rib as shown.



1. Two tabs
2. Rib

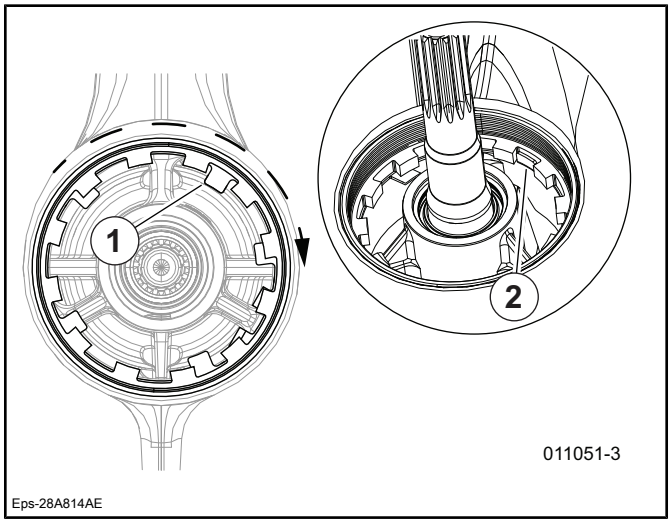
Required Tools
Spanner Nut Wrench
P/N 360054

20. Use Spanner Nut Wrench, P/N 360054, to install the spanner nut into the gearcase.
21. Tighten the spanner nut to a torque of 63 to 67 Ft. Lbs. (85.4 to 90.8 N·m).



1. Spanner nut wrench, P/N 360054

22. Continue tightening the spanner nut until one tab on the locking ring is aligned in the space between two teeth of the spanner nut. Use a suitable tool to bend the tab of the locking ring into the space.



1. Tab aligned with spanner nut
2. Tab bent up

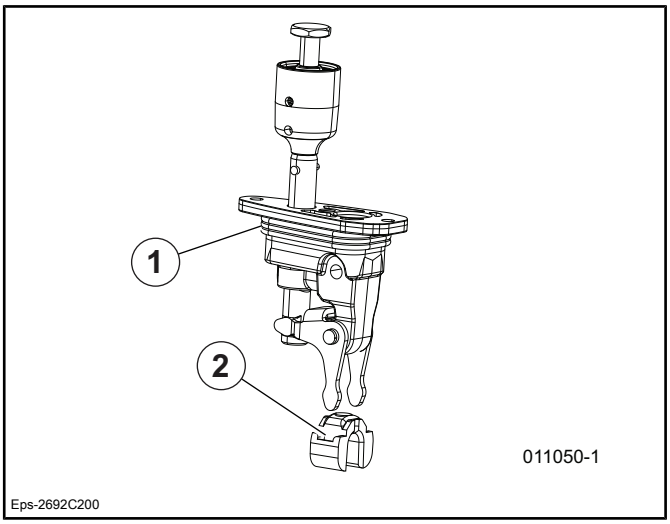
Shift Housing and Manifold Installation

1.

Required Chemical
Triple Guard Grease
P/N 508298
Needle Bearing Grease
P/N 378642

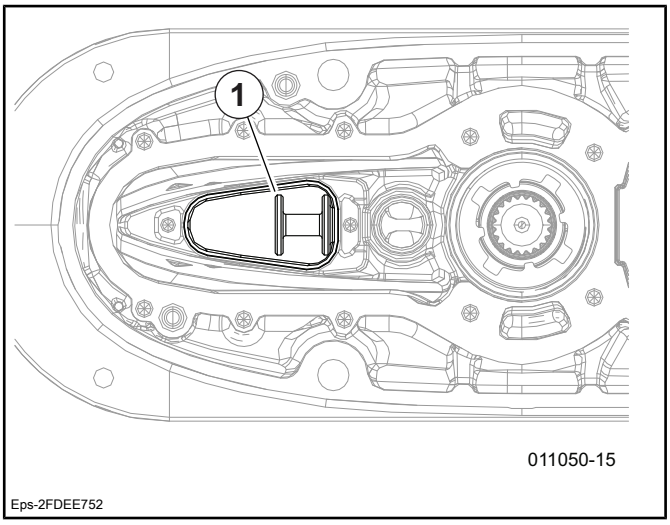
2. Apply *Triple Guard* grease to the shift housing seal.

3. Liberally apply Needle Bearing Grease, P/N 378642, to the cradle area as shown. Then place the cradle on the shift lever.



1. Seal
2. Cradle

4. Rotate the driveshaft to confirm the shifter shaft is in the NEUTRAL position. The shifter shaft should be visible as shown below.



1. Shifter shaft

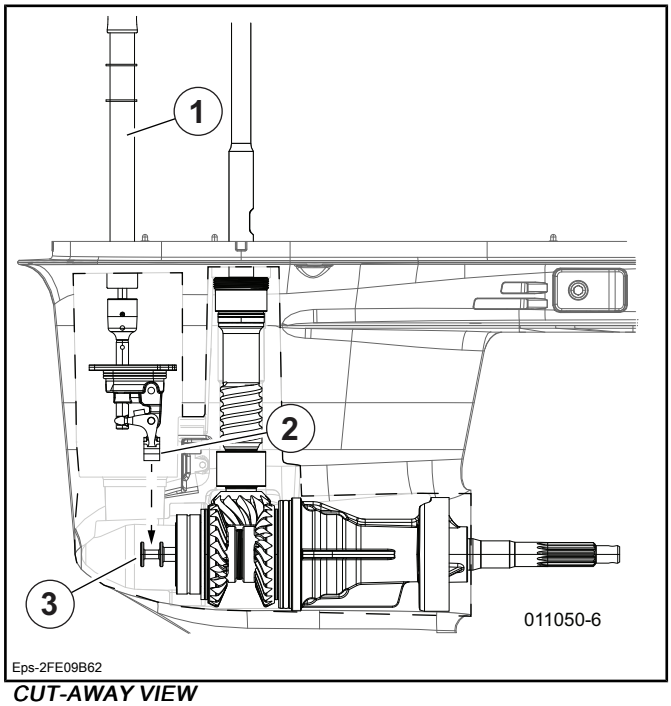
Required Tools
Shift Rod Installer/Remover
P/N 358162

5. Place the hex of the shift rod into Shift Rod Installer/Remover, P/N 358162.

IMPORTANT: Be SURE to keep the shift rod installer/ remover and shift housing assembly as close to vertical as possible. Make sure the cradle remains on the shift lever.

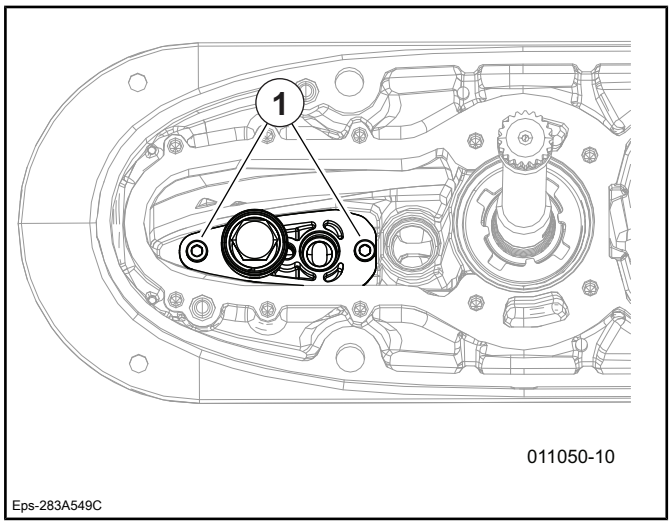
6. CAREFULLY lower the tool and shift housing assembly into the gearcase, engaging the cradle with the shifter shaft.

IMPORTANT: Do NOT force the shift housing assembly into place. If the shifter housing will not seat into the gearcase, remove and check the orientation of the cradle. If the cradle has rotated, this indicates it was bumped out of alignment. Reposition the cradle as shown and reinstall.



CUT-AWAY VIEW
1. *Shift rod installer/ remover, P/N 358162*
2. *Shift housing assembly*
3. *Shifter shaft*

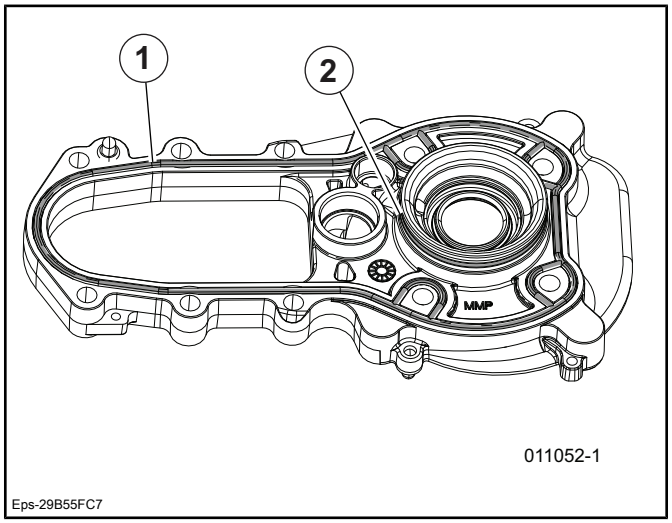
7. Install the two shift housing retainer screws. Tighten to a torque of 84 to 108 In. Lbs. (9.5 to 12.2 N·m).



1. *Screws*

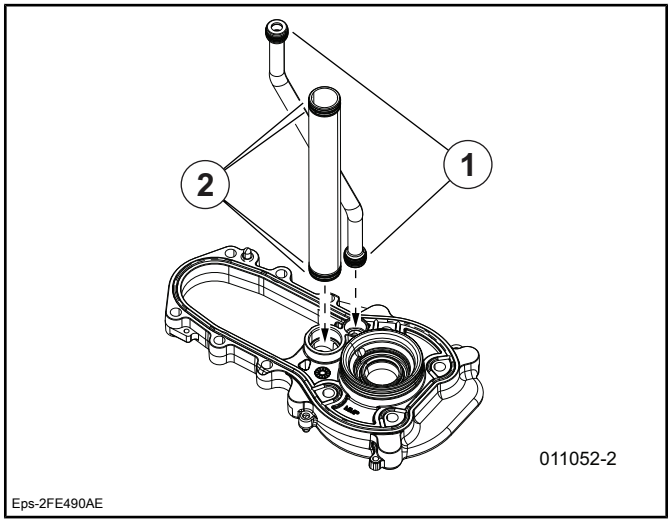
Required Chemical
Triple Guard Grease
P/N 508298

8. Install a new seal on the manifold.
9. Apply *Triple Guard* grease on a new o-ring. Install the o-ring on the manifold.



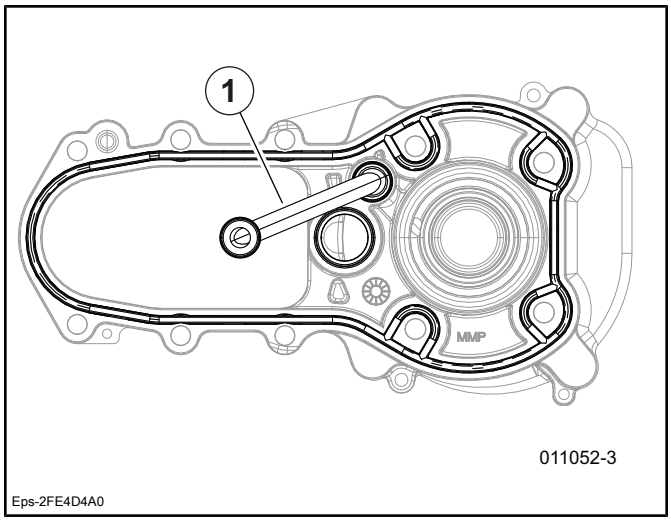
1. *Seal*
2. *O-ring*

10. Apply *Triple Guard* grease to the two new oil tube seals and four new water tube o-rings.
11. Install the seals on the oil tube and the o-rings on the water tube.
12. Install the oil tube and water tube into the manifold.



1. *Oil tube seals*
2. *Water tube o-rings*

13. Orient the oil tube as shown.



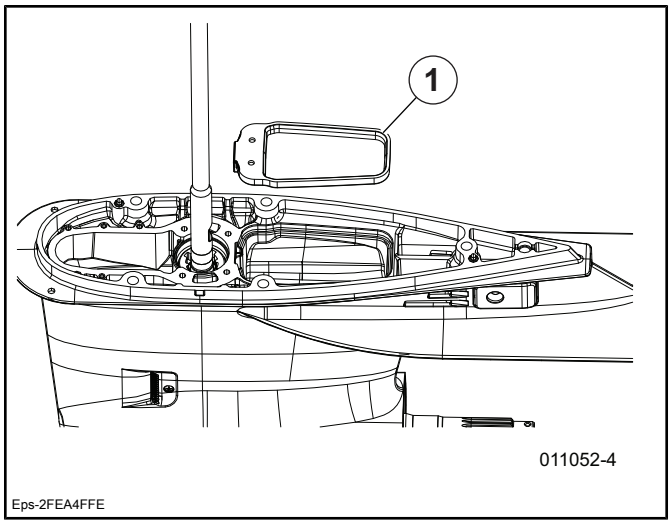
1. Oil tube orientation

Required Tools

Seal Protector

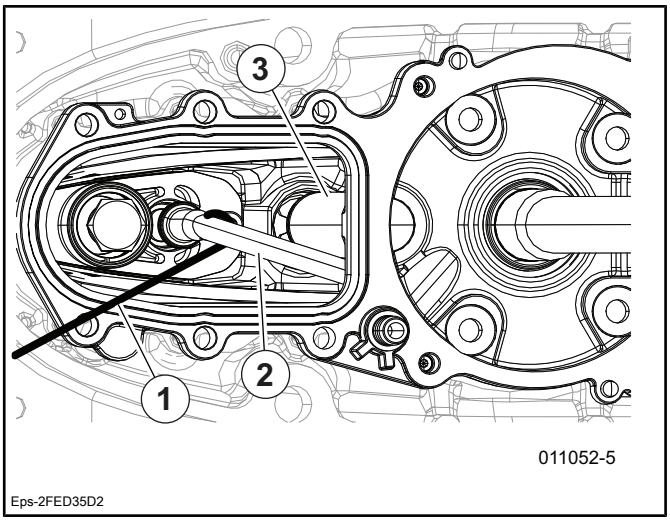
P/N 318674

14. Install the seal assembly over the gearcase housing exhaust passage.



1. Seal assembly

15. Place Seal Protector, P/N 318674, over the driveshaft splines.
16. Place the manifold assembly over the driveshaft and lower into position on the gearcase housing.
17. Use an appropriate tool, such as a long pick, or a piece of stiff wire to guide the oil tube into position. Then align the water tube and seat the manifold in place.



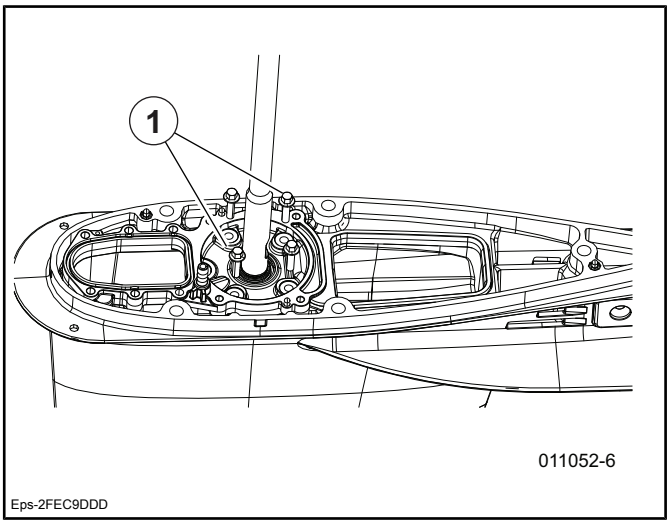
1. Tool
2. Oil tube
3. Water tube

Required Chemical

Ultra Lock (red)

P/N 500422

18. New screws have thread locking material applied.
19. If re-using screws, clean all old thread locking material from the screws. Apply Ultra Lock, P/N 500422, to the threads of the screws.
20. Install the four retaining screws and tighten to a torque of 84 to 108 In. lbs. (9.5 to 12.2 N·m).



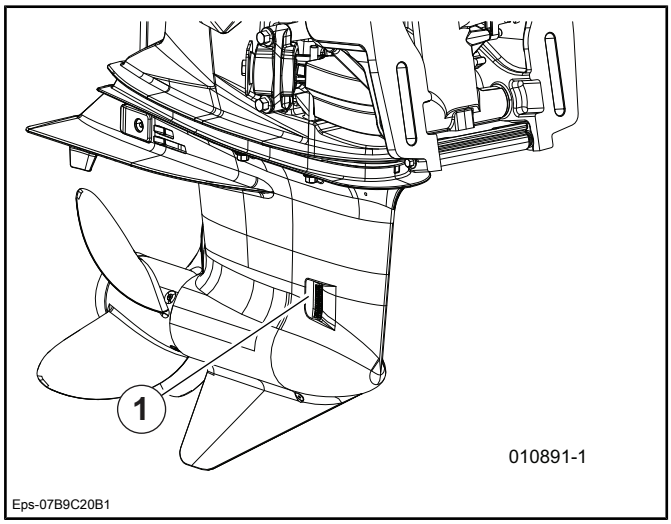
1. Screws

Water Intake Screens

Inspect condition of water intake screens. Clean or replace as needed.

IMPORTANT: Turn self-tapping screws counter clockwise to start the threads and clockwise to tighten. Failure to follow this procedure can damage the threads of the water screens.

Install water screens with one screw. Tighten screw to a torque of 18 to 30 In. lbs. (2 to 3.4 N·m).



1. Water intake screens

Confirm function of overboard water pressure indicator.

Final Assembly and Adjustment

To complete gearcase assembly, refer to:

- **Gearcase Leak Test**.
- **Water Pump Service**.
- **Shift Rod Adjustment**.
- **Shift Actuator Installation**.
- **Gearcase Lubricant**.
- **Gearcase Installation**.
- **Propeller Hardware Installation**.

During break-in period of a reassembled gearcase, change the gearcase lubricant between 10 to 20 hours of operation.

S

Safety

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Marine Products and the Safety of People Who Use Them

⚠ WARNING

This Safety section contains information relevant to the safety of boaters and people that service boats. Please read this section carefully and share it with all shop technicians. Always follow common shop safety practices. If you have not had training related to common shop safety practices, you should do so not only to protect yourself, but also to protect the people around you. It is impossible for this manual to cover every potentially hazardous situation you may encounter. However, your understanding and adherence to the recommendations contained in this manual and use of good judgment when servicing outboards will help promote safety. Always be alert and careful: a good foundation for safety.

Enjoyable boating is the goal of people who design and build marine products. To reach this goal, manufacturers are careful to make sure:

– Product user is informed; and
– Products are safe and reliable.

It is up to you, the people who...

– Rig boats;
– Fix machinery; and
– Maintain equipment

...to keep the products safe and reliable.

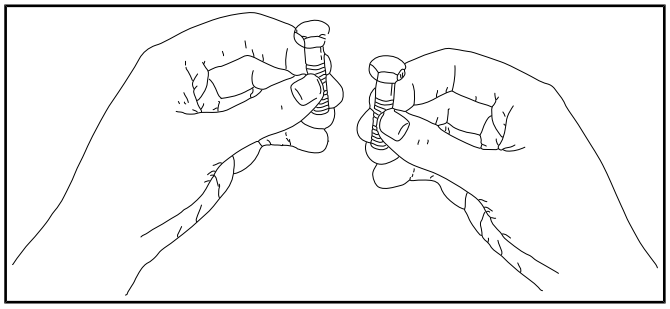
This section talks about safe boating and how you can help make it safe. Some of these safety issues you will know, others you may not.

First!

A word about parts... Plain parts; special parts; all parts!

DO NOT SUBSTITUTE PARTS

"They look the same, but are they the same?"



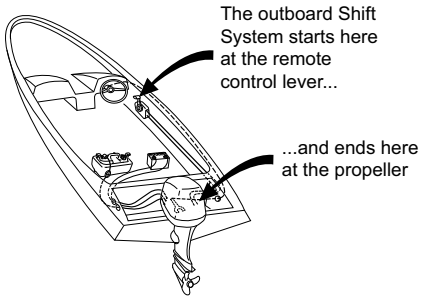
- Same size?
- Same strength?
- Same material?
- Same type?

Don't substitute unless **you know** they are the **same** in **all** characteristics.

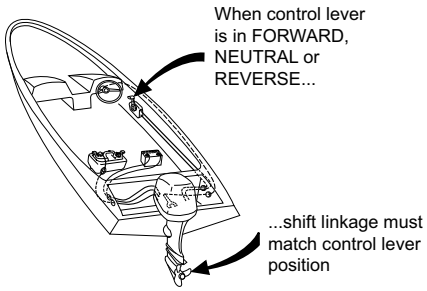
Second!

- Special locking bolts and nuts are often used to hold steering, shift, and throttle remote control cables to the outboard.
- When you take any outboard off a boat, keep track of special nuts and bolts. Do not mix with other parts. Store them on the outboard, then they are there when you need them.

Outboard Shift Systems and Safety



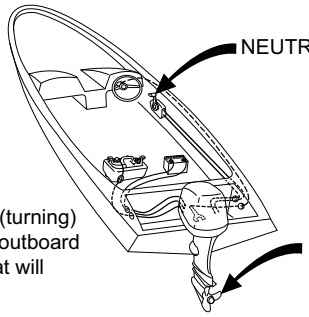
What is most important?



What could happen?

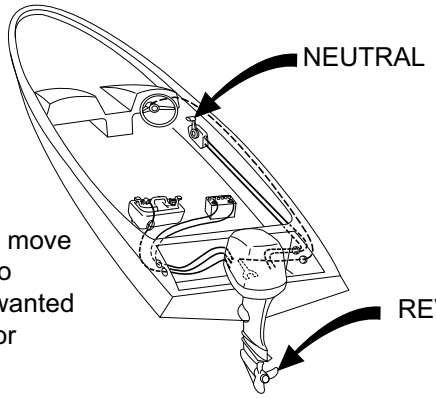
IF...

...propeller still powered (turning) unknown to operator, or outboard will start in gear, and boat will move suddenly



IF...

...boat will move opposite to direction wanted by operator



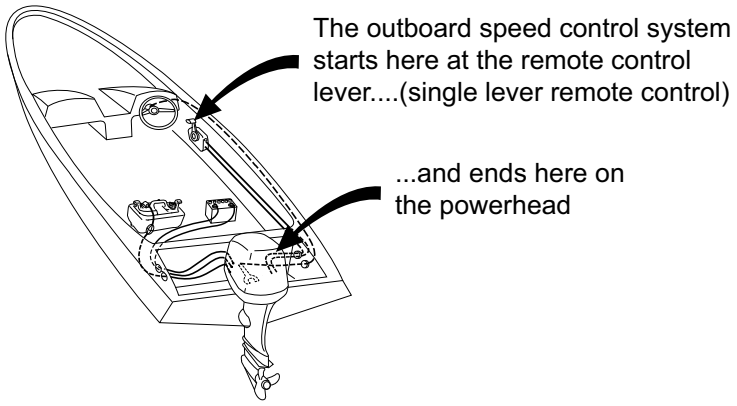
How can loss of shift control be minimized?

When rigging or after servicing

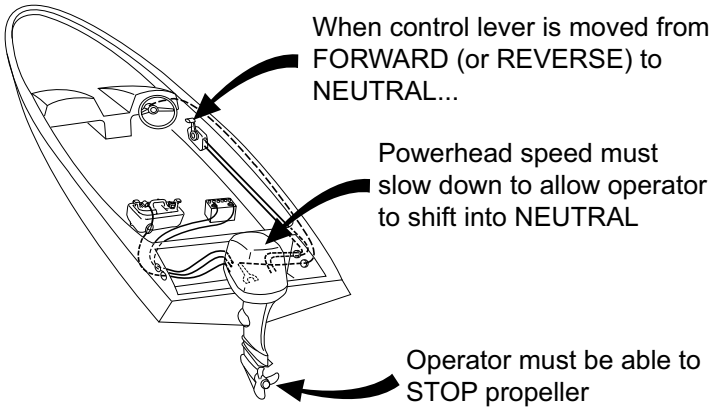
Read, understand, and follow manufacturer's instructions

- Follow warnings closely
- Assemble parts carefully
- Make adjustments carefully
- Test your work. Do not guess. Make sure propeller does just what the operator wants and nothing else.
- Do not shift gears on a stopped outboard. Adjustments can be lost and parts weakened.

Outboard Speed Control System and Safety



What is most important?



What could happen?

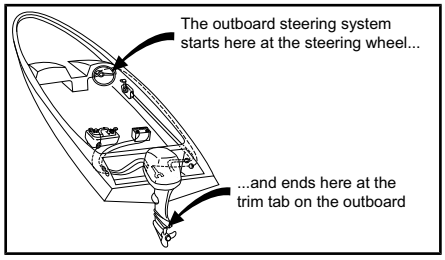
If Operator cannot slow down the outboard or shift into NEUTRAL gear (stop propeller), Operator could panic and lose control of boat.

How can loss of speed control be minimized?

When rigging or after servicing	**Read, understand, and follow manufacturer's instructions** – Follow warnings closely – Assembly parts carefully – Make adjustments carefully – Test your work. Do not guess. Make sure speed control system does just what the operator wants and nothing else. – Make sure full throttle can be obtained so operator will not overload parts

S

Outboard Steering Control System and Safety

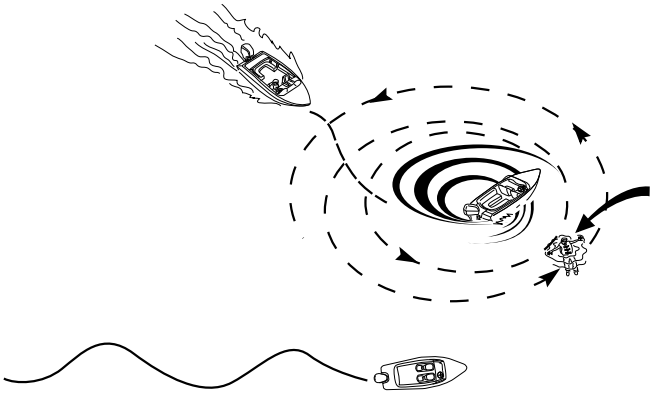


What is most important?

The steering system:
- Must not come apart
- Must not jam; and
- Must not be sloppy or loose

What could happen?

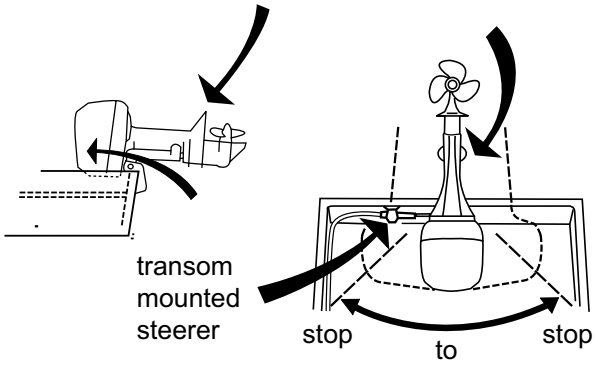
- If steering system comes apart, boat might turn suddenly and circle. Persons thrown in the water could be hit.
- If steering jams, operator may not be able to avoid obstacles. Operator could panic.
- If steering is loose, boat may weave while operator tries to steer a straight course. With some rigs (at high speed), loose steering could lead to loss of boat control.



How can loss of steering control be minimized?

When rigging or after servicing	– Use a steering system recommended by the outboard manufacturer which meets Marine Industry Safety Standards (ABYC). – Read, understand, and follow manufacturer's instructions – Follow warnings closely – Assemble parts carefully – Make adjustments carefully – Keep parts moving freely. Lubricate parts as shown in manual. – Use the bolts, nuts and washers supplied with steering attachment kits — they are a special locking type that will not loosen, rust, or weaken.

Transom Mounted Steering Systems — Check to Uncover Possible Trouble

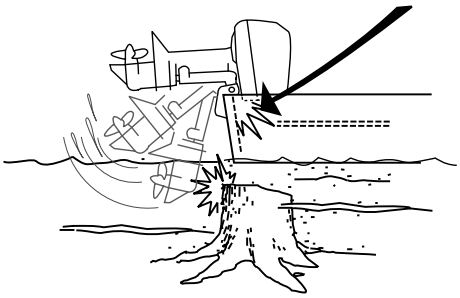


During this procedure, steering parts:

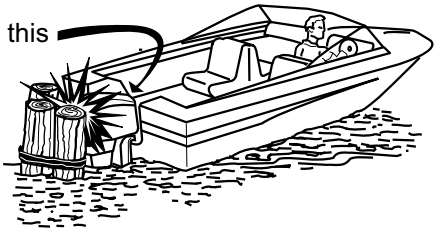
– Must not bind; and
– Must not touch other boat, outboard, or accessory parts in transom area.

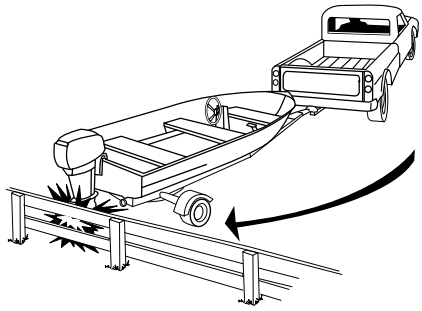
Why? A hard blow to the outboard's gearcase can result in damage to steering parts.

Be aware that raising or lowering outboard on transom can change a set-up which was OK earlier. If moved up or down even one-half inch, run test again to make sure steering parts are free and clear.



Check for damaged parts/ Blows to the outboard like this

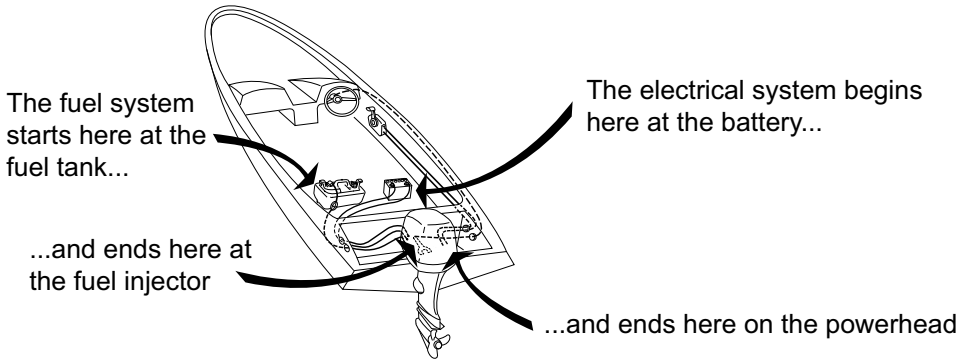




or this can put heavy loads on steering parts
- Cracked parts, including steering parts, swivel brackets, and transom brackets;
- Bent parts; and
- Loose nuts and bolts

Replace damaged parts. If weakened, parts could fail later on the water when least expected.

Outboard Fuel, Electrical System, and Safety



What is most important?

- Fuel leakage must be eliminated
- Stray electric sparks must be avoided

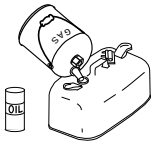
What could happen?

- **When not boating**, fuel leaking in car trunk or van, or place where portable tank is stored (basement or cottage), could be ignited by any open flame or spark (furnace pilot light, etc.).
- **When boating**, fuel leaking under the engine cover could be ignited by a damaged or deteriorated electrical part or loose wire connection making stray sparks.

How Can Fire and Explosion Be Minimized?

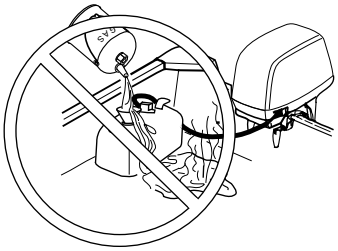
- Read, understand, and follow manufacturer's instructions
- Follow warnings closely.
- Do not substitute fuel or electrical systems parts with other parts which may look the same. Some electrical parts, like starter motors, are of special design to prevent stray sparks outside their cases.
- Replace wires, sleeves, and boots which are cracked or torn or look in poor condition.

When mixing and refueling, always mix gas and oil outside...



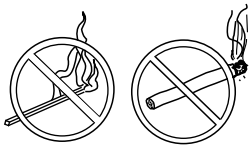
Do not use electrical devices such as cellular phones in the vicinity of a fuel leakor while fueling

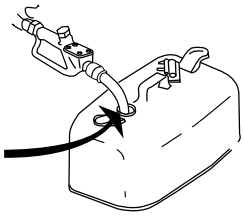
If you use a funnel, it has to be metal to ground the spout to



Always fill the tank outside the boat. Fumes are hard to control. They collect and hide in the bottom of the boat.

Remember...





To avoid static electricity sparks, ground (touch) the spout against the tank

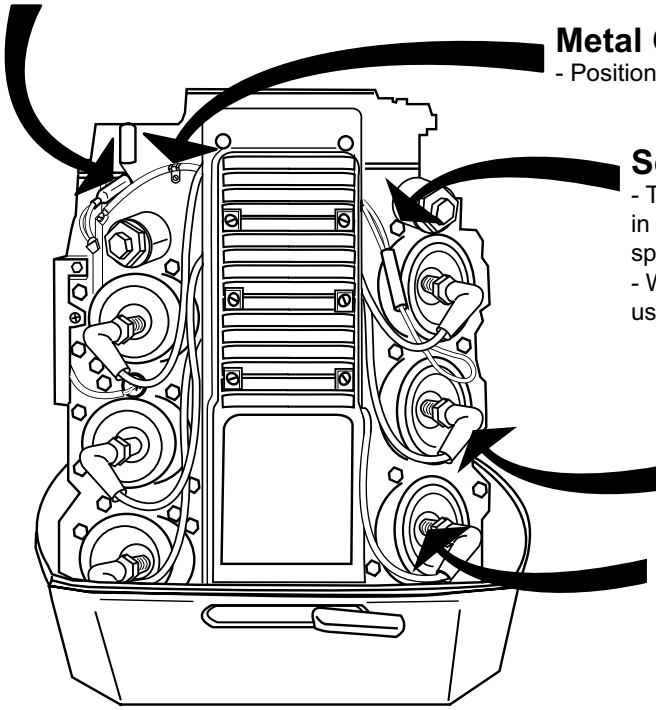
If electrical parts are replaced or even removed from the outboard, check the following:

Wire and high voltage lead routing

– As shown in service manual
– Away from moving parts which could cut wires or wire insulation
– Away from engine cover latches which can catch and cut insulation from high voltage spark plug leads

Sleeves, boots, shields

- In position (to avoid schock hazard)
- Not torn or cracked



Metal Clamps - Tie Straps

- Position as shown in the manual

Screws, Nuts , Washers

- Tighten firmly - these keep clamps in position and ends of wires from sparking
- Where lock washers are called for, use them

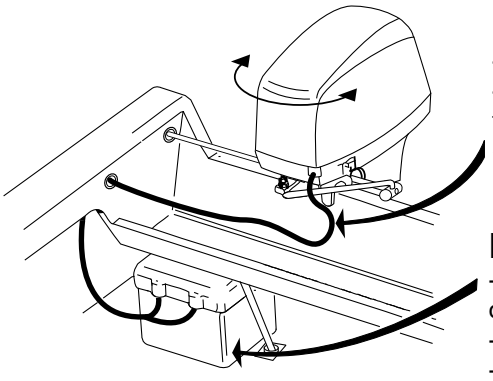
Spark Plug Boots

- Not torn or cracked
- Fully pushed onto spark plug

Spark Plugs

- Avoid rough handling that could crack ceramic part of plug. (Sparks may jump across outside of plug)

In transom area:



Electric Cable

- Not rubbing on sharp objects
- Enough slack to allow full turning without pull loads on cable (prevents sparks)

All Connections

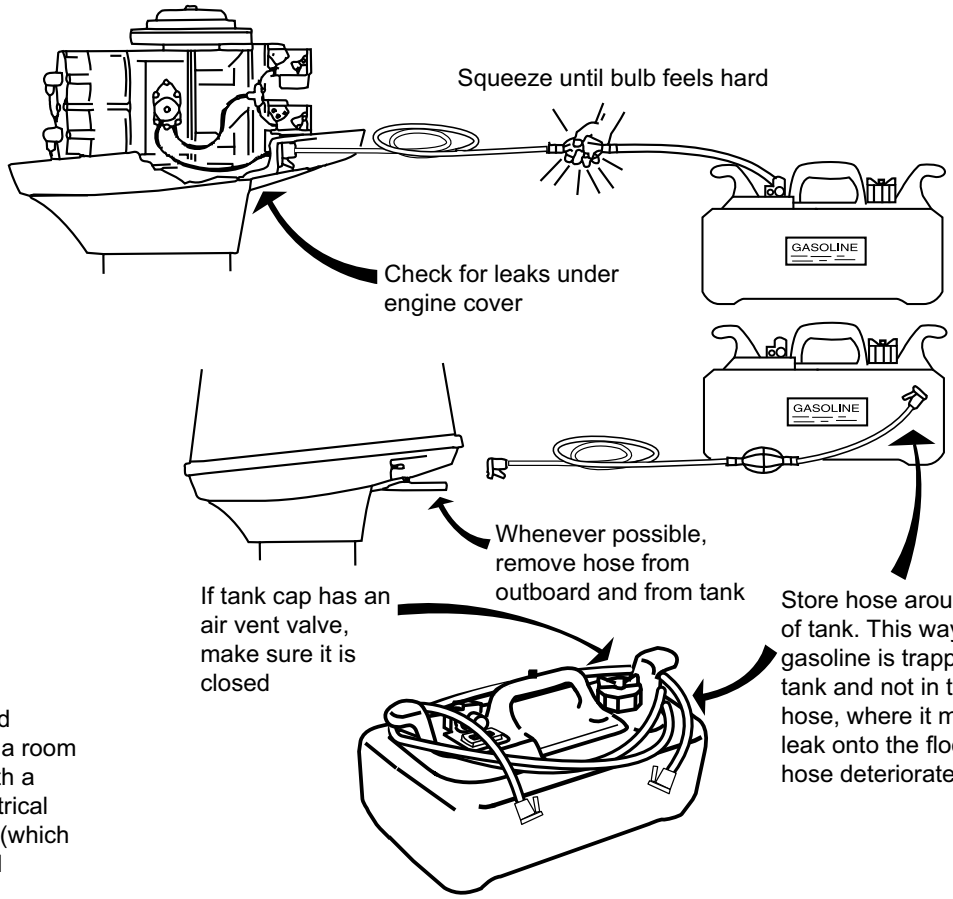
– Clean
– Tight (Prevents sparks)

Batteries

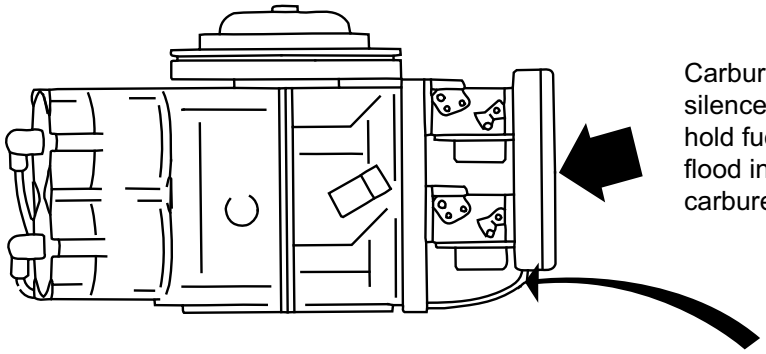
- Secure in approved battery box or battery tray
- Battery terminals insulated
- No strain on cables

After repair on any part of the fuel system, pressure test engine portion of fuel system as shown:

When storing:



If gasoline tank is stored indoors, do not put it in a room having an appliance with a pilot light or where electrical appliances or switches (which may spark) will be used

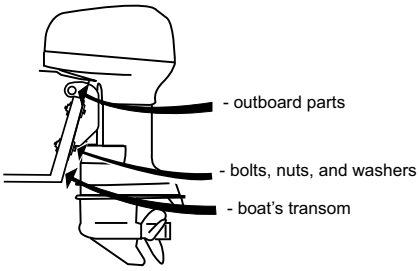


- **Make sure silencer and its gaskets are on engine and drain hose is in place.**
- **Air silencer mounting screws are special lock screws. Use only the special screws.**

S

Outboard Mounting System and Safety

The mounting system includes:



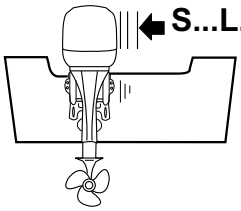
What is most important?

– Outboard must stay in position on boat's transom

What could happen?

Outboard may

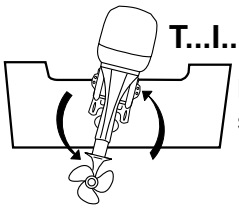
– If outboard hits something solid and does not stay on the transom, boat occupants may be injured from the outboard or its parts entering the boat.



S...L...I...D...E on transom

Boat may turn and be hard to steer

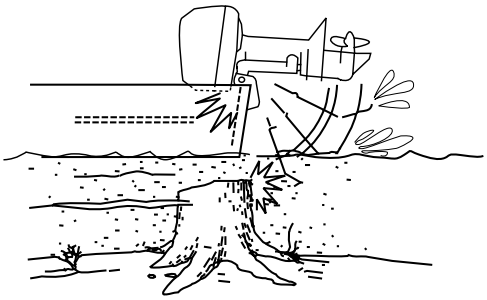
Outboard may



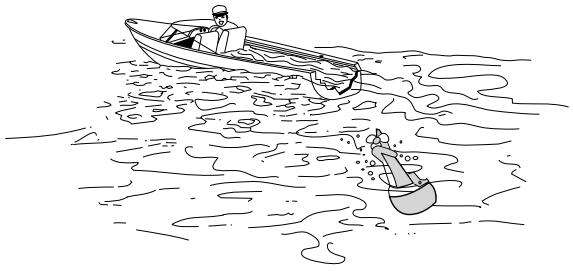
T...I...L...T on transom

Boat may turn and be hard to steer

Boat's transom could break away



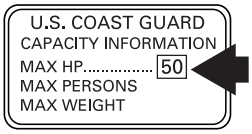
Outboard may be lost overboard.
Boat may **SINK**.



How Can Loss of Mounting Be Minimized?

– Read, understand, and follow manufacturer's instructions
– Follow warnings closely.

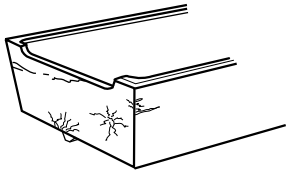
If weakened, parts could fail later on the water, when not expected



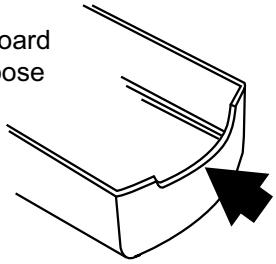
If boat plate shows...

Use only

When rigging or fixing any boat, if transom looks weak, tell the

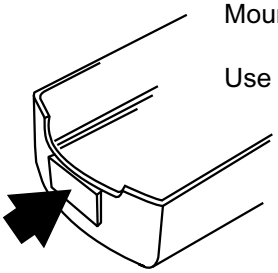


If transom is curved, outboard may come loose

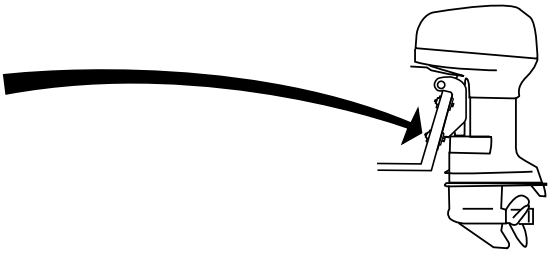


Mount on flat surface only.

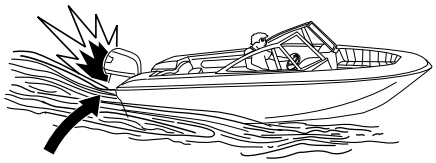
Use shims to make surface flat



Use bolts, nuts, and washers supplied with outboard. They are usually special and will not rust or weaken.

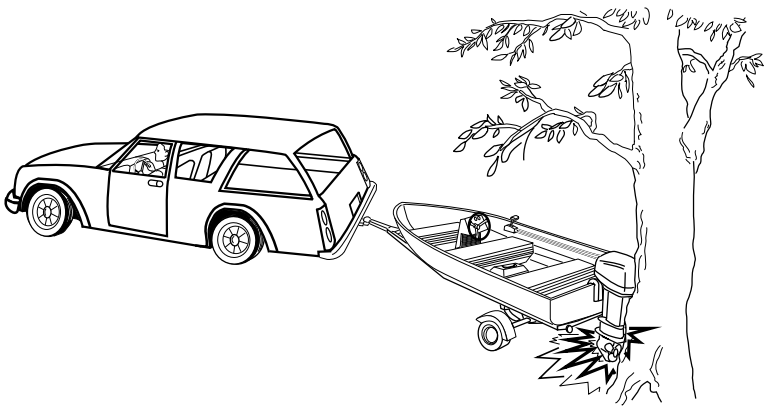


If owner tells you “I hit something really hard...”



Check for a high speed blow to the lower unit.

OR...



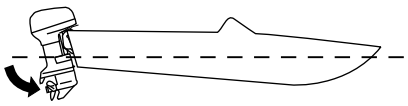
"I was backing up and I think the outboard may have hit a tree or something."

Check for a slow, heavy squash to the outboard.
-Look for damaged parts and loosened nuts and bolts in both the steering and mounting systems. Replace damaged parts.

Outboard Hydraulic Tilt/Trim Shock Absorption System and Safety

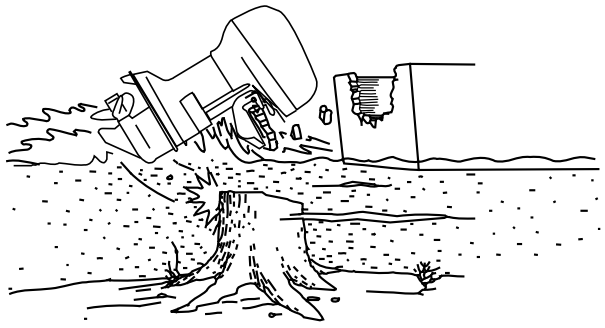
What is most important?

- Shock absorption system must always be ready to absorb some blows to the lower parts of the outboard.
- Outboard must not trim in too far suddenly.



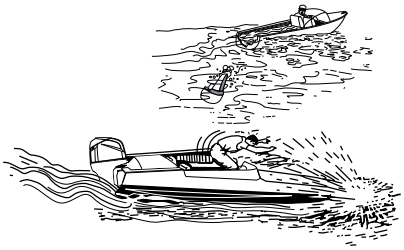
What can happen?

Without shock protection, a blow like this could cause serious damage to the outboard and injury to boat occupants from the outboard or its parts entering the boat. Transom could break away and outboard may be lost overboard.



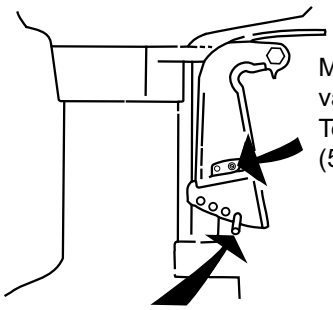
At high speeds, sudden trimming in too far may dive the boat under water or spin it around.

Boat may **SINK**



How can possible conditions be minimized?

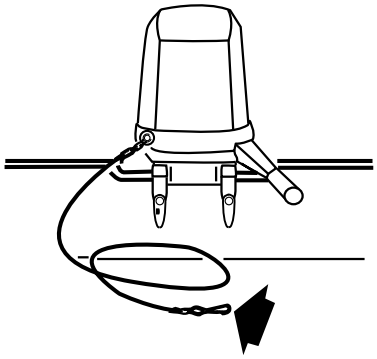
- Read, understand, and follow manufacturer's instructions.
- Follow warnings closely.
- Test your work whenever possible.
- If oil leaks are seen in service areas, determine source. Keep reservoir filled.
- If outboard is hydraulic tilt/trim model, always return rod to hole position determined by boat operator and make sure angle adjusting rod retain is in locked position.

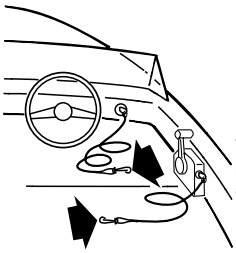


Make sure manual release valve is closed tight. Torque to 45 to 55 in. lbs. (5.1 to 6.2 N·m).

Trimming "in" too far can happen when angle adjusting rod is not in the right hole or is not in any hole (lost)

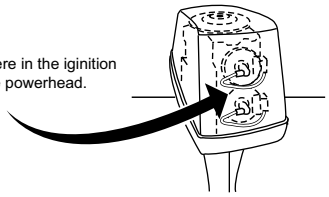
Outboard Emergency Stop System





The emergency system begins here at the clip and lanyard...

...and ends here in the iginition system on the powerhead.



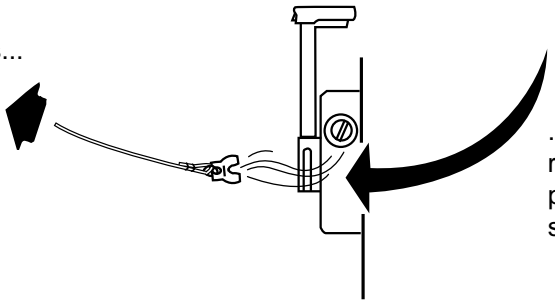
What is most important?

- The emergency stop system must **STOP** the engine when the clip is removed or the lanyard pulled from the emergency stop / key switch.

S

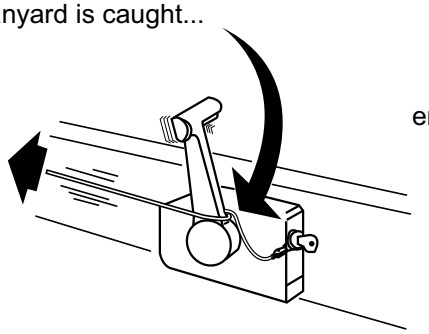
What could happen?

If switch fails...



...engine will keep running when clip is pulled from the switch

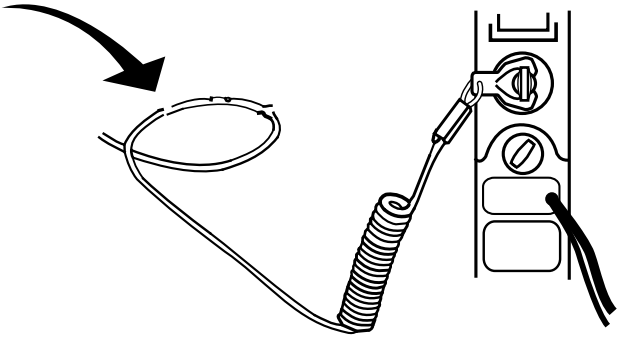
If lanyard is caught...



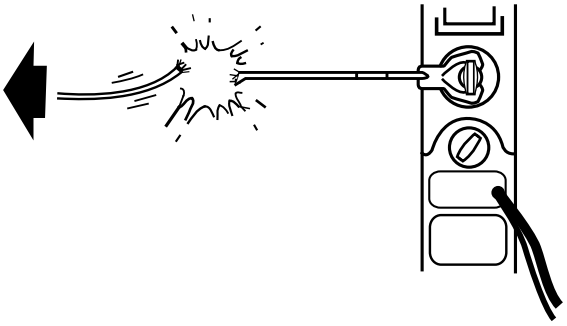
enigne will keep running.

What could happen?

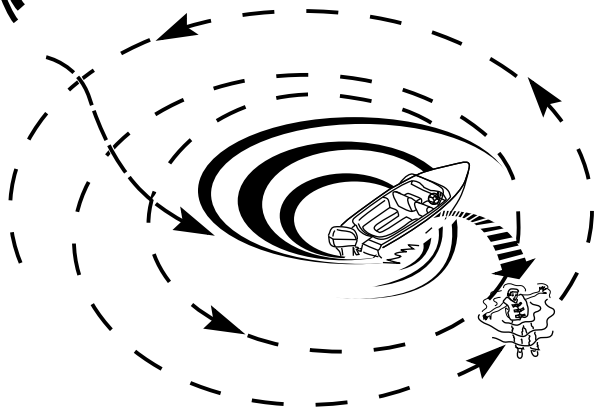
If lanyard is cut or frayed...



...lanyard or clip may break when pulled



If engine does NOT stop when lanyard is pulled, an operator thrown from the boat could be hit as boat circles area. Or, boat may not turn to leave area as a runaway. Operator may drown and boat WILL run into something



How can failure of the emergency stop system be minimized?

When rigging or after servicing

- Read, understand, and follow manufacturer's instructions
- Follow warnings closely
- Assembly parts carefully
- Inspect lanyard for cuts or fraying; clip for wear. Replace with original parts. Do not substitute.
- Locate control box and other items in area to keep lanyard from being caught.
- **ALWAYS TEST EMERGENCY STOP SYSTEM. PULL LANYARD. ENGINE MUST STOP. IF IT DOES NOT, REPAIR BEFORE NEXT USE.**

Summary

Now you know some things that can take the joy out of boating.

No doubt about it — proper safety takes time!

– Reading and understanding instructions
– Re-reading warnings
– Putting parts together correctly
– Making correct adjustments
– Testing your work

And making sure

– Worn or damaged parts are replaced
– Replaced parts are like originals in every way
– Customer is told of things which need attention

But, do you really want the alternative?

Marine Products and the Safety of People Who Fix Them

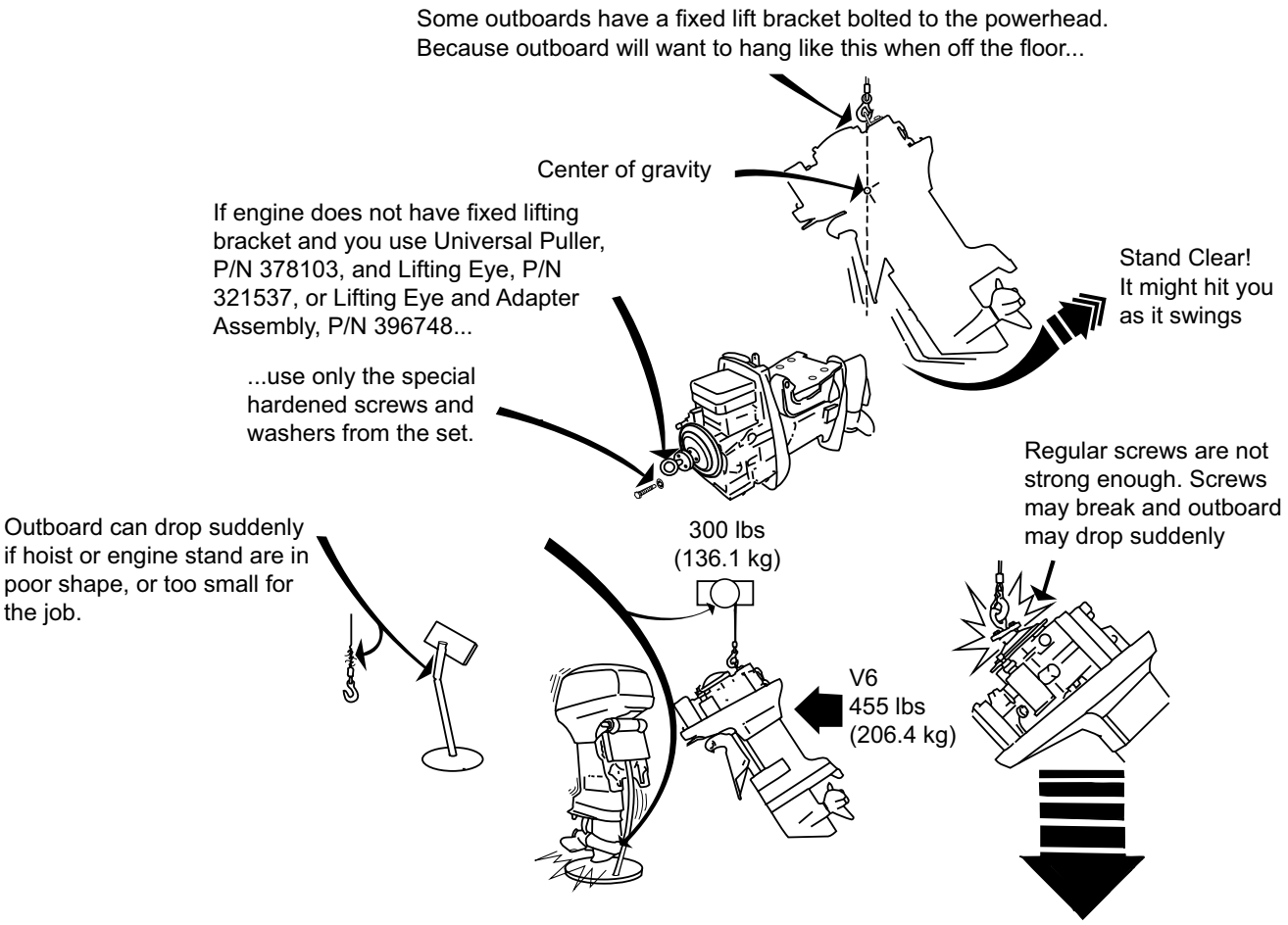
The first part of this Safety section talked about safe boating and how you, the technician, can help keep it safe for the boater. But what about you? Technicians can be hurt while:

– Rigging boats
– Troubleshooting problems
– Fixing components
– Testing their work

Some of these safety issues you will know, others you may not.

Handling Outboards

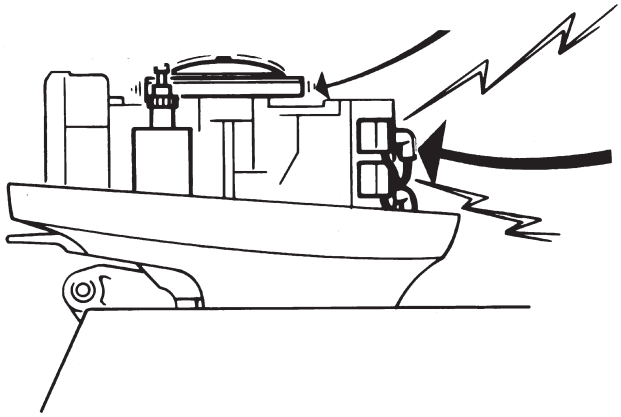
When lifting outboards



– Make sure shop aids have extra capacity, and keep them in good repair.

Running outboard with engine cover removed

Engine cover is a guard. When you remove cover/guard to work on the outboard, remember: loose clothing (open shirt sleeves, neckties), hair, jewelry (rings, watches, bracelets), hands and arms can be caught by the spinning flywheel.

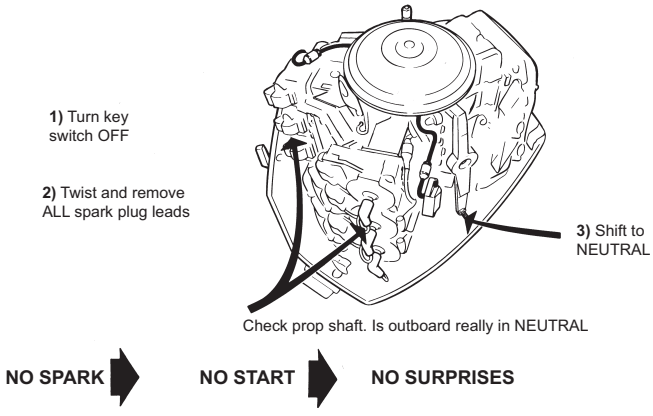


Handling high voltage parts like spark plugs and coils can shock you and may cause you to recoil into the rotating flywheel.

– Two people working together on a live outboard must look out for each other. Never, ever, use the key to start the outboard before signaling your partner. He may be leaning over the outboard with hands on the flywheel, handling a “hot” electrical part, or near the propeller.

Outboard starting at the wrong time

When you do things that turn the flywheel like:
– Off-season storage fogging (oiling) of outboard;
– Removing propeller with a powered tool;
– Electrical system checks;
– Servicing the flywheel; or
– Any other actions **ALWAYS**...

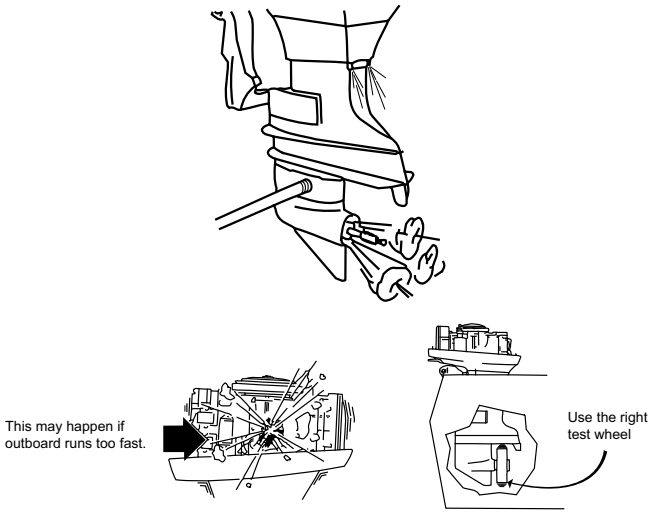


Running outboard too fast (Overspeeding)

– “Too fast” means running faster than outboard normally runs on boat.

Running to fast can happen when:

1. Using a flushing device
   Turn on water before starting outboard. Keep engine speed below 2000 RPM. With no load, outboard will run too fast very easily. Wear eye protectors.
2. Running with the wrong test wheel...



Running outboards: Exhaust fumes

⚠ DANGER

DO NOT run the engine indoors or without adequate ventilation or permit exhaust fumes to accumulate in confined areas. Engine exhaust contains carbon monoxide which, if inhaled, can cause serious brain damage or death.

– Whenever running the engine, assure there is proper ventilation to avoid the accumulation of carbon monoxide (CO), which is odorless, colorless, and tasteless, and can lead to unconsciousness, brain damage, or death if inhaled in sufficient concentrations. CO accumulation can occur while docked, anchored, or underway, and in many confined areas such as the boat cabin, cockpit, swim platform, and heads. It can be worsened or caused by weather, mooring and operating conditions, and other boats. Avoid exhaust fumes from the engine or other boats, provide proper ventilation, shut off the engine when not needed, and be aware of the risk of backdrafting and conditions that create CO accumulation. In high concentrations, CO can be fatal within minutes. Lower concentrations are just as lethal over long periods of time.

Running outboards: Propellers

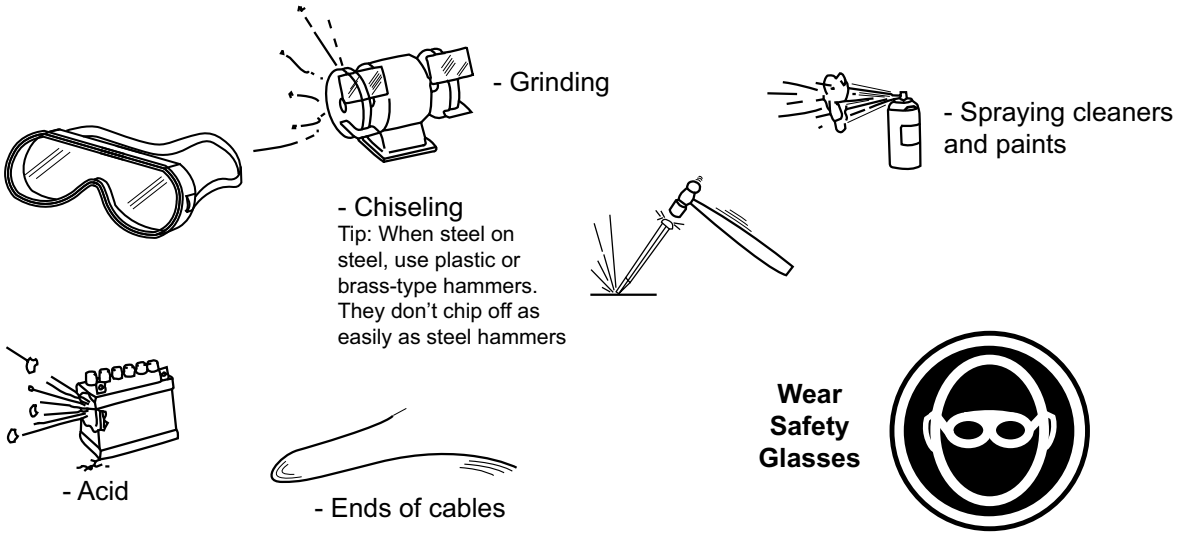
⚠ DANGER

Contact with a rotating propeller is likely to result in serious injury or death. Assure the engine and prop area is clear of people and objects before starting engine or operating boat. Do not allow anyone near a propeller, even when the engine is off. Blades can be sharp and the propeller can continue to turn even after the engine is off. Always shut off the engine when near people in the water.

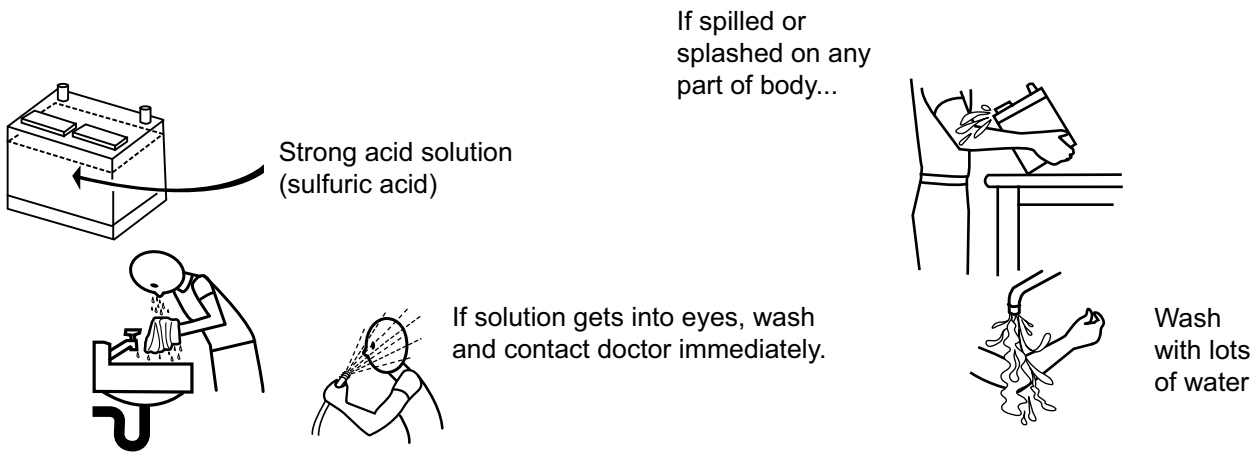
S

Eye protection

Eyes need protection when:

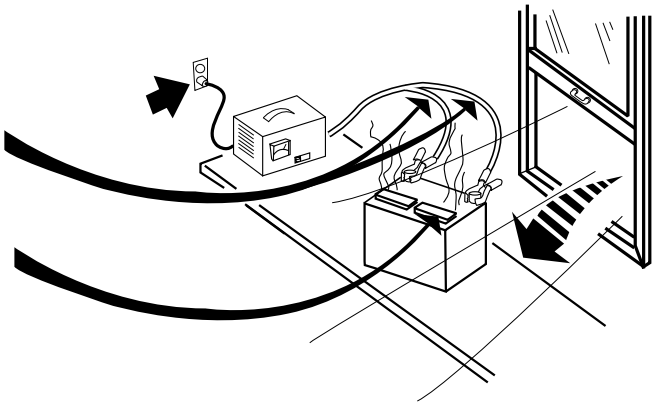


Handling Lead/Acid Batteries



Charging lead acid batteries

1. Attach and remove these cables with charger UNPLUGGED from 110 V wall socket. (This prevents shocks if charger is defective.)
2. Observe correct polarity when connecting these larger leads.
3. Always charge in a well ventilated area. Charging causes acid solution to give off hydrogen gas through the vents in the caps. **Make sure vents are open**. If clogged, pressure inside may build. Battery may EXPLODE.



Battery gas is explosive!

While charging or discharging remember:

- No smoking
- No flames
- No sparks

Never remove charger cables from battery posts. It is a sure way to make a lot of sparks in an area surrounded by battery gas.

After charging:

- Shut off charger
- Pull charger plug out of 110 V outlet
- Take charger cables off battery posts

DO NOT check battery charge by placing metal objects across posts. You will make sparks and serious burns are possible.

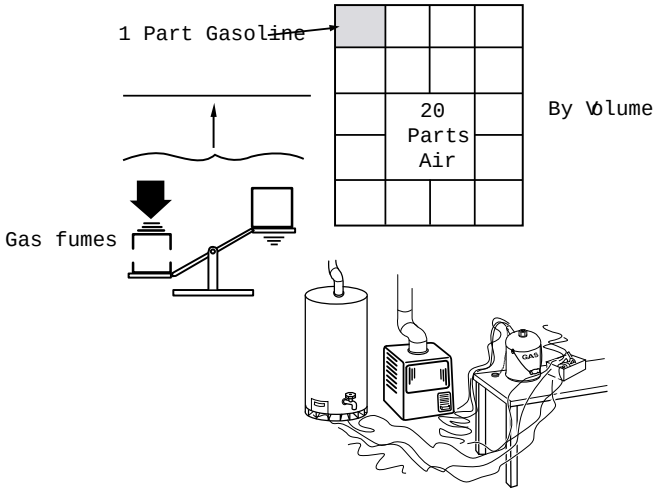
Gasoline – Handle With Care!

Gasoline vapor and air mixtures explode easily and violently when mixed as shown...

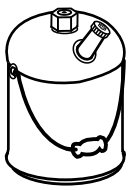
When you smell ANY odor of gasoline, explosion is possible.

Gasoline fumes are heavy and will sink to the lowest point in the boat or room and will STAY there, WAITING...

If the air around you is calm, the pilot light in the heater could ignite the heavy fumes before your nose ever smells the fumes.



What can you do?



Store gasoline in sturdy, approved, sealed gas can and keep outside.

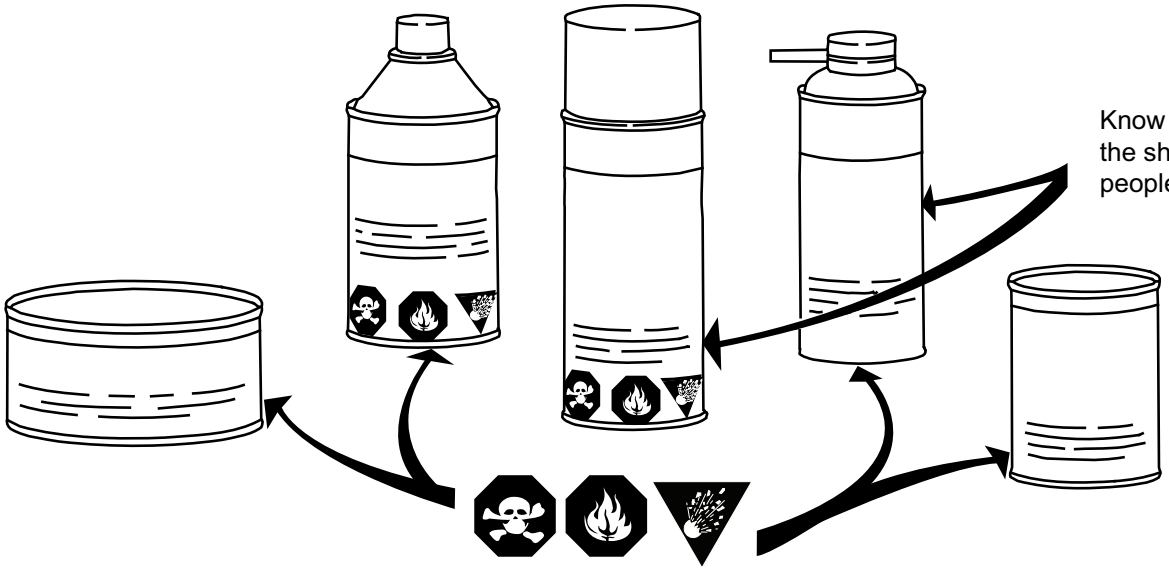
- Always store gasoline outside in a safe can (flame arrester and pressure relief valve in pour spout).
- Fill portable tanks outside of boat. Spillage will collect in bottom of boat.
- Use fuel as fuel ONLY, not for a cleaner or degreaser.
- If fumes are smelled in shop, basement, or garage, immediately:
  - Put out open flames, cigarettes, sparking devices;
  - Wipe up spill or leak;
  - Get towels and rags outside fast;
  - Open doors and windows; and
  - Check **lowest** area for fumes.

Be aware of items in and around repair area which can ignite fumes. Control them if fumes are smelled.

- Matches, cigarettes, blow torches, welders
- Electric motors (with unsealed cases)
- Electric generators (with unsealed cases)
- Light switches
- Appliance pilot lights or electric ignitors (furnace, dryer, water heaters)
- Loose wires on running outboards
- Other variables which may ignite fumes

How many of these are in your repair area?

Hazardous Products



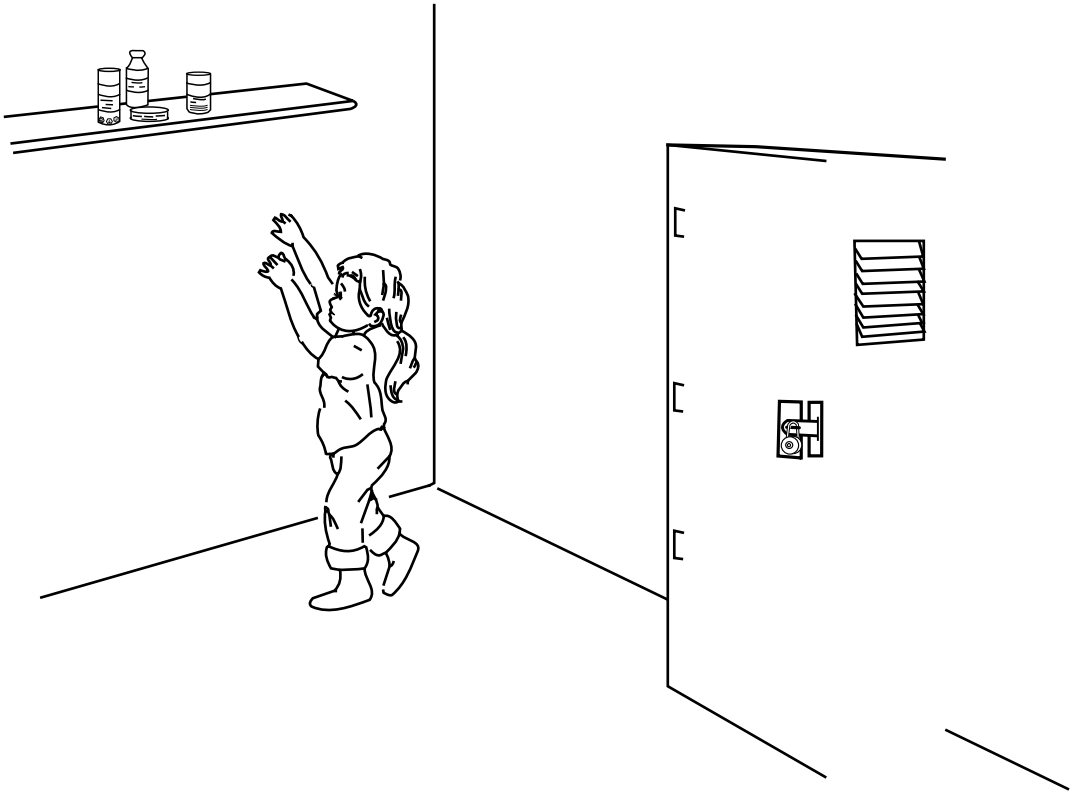
Know how items in the shop can hurt people...

READ

- "How and where to use"
- "How to give First Aid." Have recommended First Aid materials on hand should an emergency arise
- "How to dispose of can"

It all on the **back of the can or bottle label**.

And remember: little children are very curios and will try to taste everything so **keep containers away from children!**



Safety Awareness Test

The Technician's Safety Awareness Test....

1. Did you read this Safety section?
2. Are you ready to take responsibility for the safe maintenance practices and procedures of your repair shop, co-workers, and technicians?
3. Do you understand all the safety precautions and instructions contained in this entire service manual?
4. Will you follow all safety warnings, precautions, instructions and recommendations outlined in this service manual?
5. Do you understand that the service manual as a whole and this Safety section, in particular, contain essential information to help prevent personal injury and damage to equipment and your customers?
6. Have you received training related to common shop safety practices to protect your-self and others around you?
7. When replacement parts are required, will you use *Evinrude/Johnson Genuine Parts* or parts with equivalent characteristics, including type, strength and material?
8. Are you ready to follow the recommendations in this service manual before you service any boat or outboard?
9. Do you understand that safety related accidents can be caused by carelessness, fatigue, overload, preoccupation, unfamiliarity of operator with the product, drugs and alcohol, just to name a few?

Notes

Technician's Notes

Related Documents

Bulletins	
Instruction Sheets	
Other	

Trouble Check Chart

Outboard Will Not Start

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard does not turn over	Battery switch not ON	Check battery switch operation
	Discharged battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections. Check for voltage drop in starter circuit.
	Faulty connection or ground, damaged electrical harness	Check all grounds, connections and wiring
	Fuse	Check wiring, then replace faulty fuse
	Wiring harness	Check for 12 V at terminal “B” of key switch
	Key switch	Check key switch operation
	Starter solenoid	Check wiring and test solenoid
	Starter or bendix/drive gears	Check starter, inspect bendix/ drive gears
	Seized powerhead or gearcase	Check and repair as needed
Outboard turns slowly	Discharged battery	Check battery, recharge or replace
	Battery cable and connections	Clean and tighten connections. Check voltage drop in starter circuit.
	Powerhead hydro-locked	Check cylinders for water
	Partially seized powerhead or gearcase	Check and repair as needed
	Starter or bendix/drive gears	Check starter, inspect bendix/ drive gears

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard turns over	Stop circuit grounded	Check wiring and emergency stop switch. Check the safety lanyard is installed and stop circuit is not grounded.
	No Fuel	Check for fuel in fuel tank
	Water in fuel	Check fuel filter, sample fuel from fuel return manifold.
	Contaminated or poor fuel quality	Check or replace fuel supply
	Fuel supply restricted	Check anti-siphon valve, and fuel pick-up. Prime fuel system to fill vapor separator with fuel.
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Low or no fuel pressure to injectors	Check fuel manifold pressure, refer to Fuel System
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Fuel injectors not working	Check voltage at injectors
	Excessive fuel or oil, engine flooded	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent, refer to System Analysis
	Low or no 55 V alternator output	Check voltage on 55 V circuit, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuits, refer to System Analysis and Electrical and Ignition
	Ignition	Check ignition, refer to System Analysis and Electrical and Ignition
	CPS input to EMM, no sync	Check RPM reading while cranking
	No ignition system primary voltage output from EMM to ignition coils	Check cranking RPM (300 minimum), refer to System Analysis
	Low or no compression	Check compression
	Water in engine	Check condition of spark plugs and cylinders
	Internal powerhead damage	Check and repair as needed
	Leaking cylinder/crankcase, intake manifold, or reed valves	Check and repair as needed

Outboard Hard To Start

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard eventually starts, may or may not run properly once started	Weak battery	Check battery, recharge or replace
	Battery cables and connections	Clean and tighten connections, check voltage drop on high amperage circuit
	Starter or bendix/drive gears	Check starter, inspect bendix/ drive gears
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check or replace fuel supply
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low fuel pressure	Check pressure, refer to Fuel System
	Fuel supply restricted	Check anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low or no alternator output (55 V)	Check voltage on 55 V circuit, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to System Analysis and Electrical and Ignition
	Restricted or leaking fuel injector(s)	Check injectors, refer to Fuel System
	Weak or erratic ignition operation	Check ignition, refer to System Analysis and Electrical and Ignition
	Crankshaft Position Sensor (CPS)	Check CPS air gap and EMM LED indicators
	Excessive fuel or oil, engine flooding	Check for leaking injectors, leaking fuel or oil lift pump, or leaking vapor separator vent. Refer to System Analysis.
	EMM program, timing, or operation	Check EMM program and timing; check injector coefficients; and monitor injector circuits and ignition primary

Outboard Will Not Shut Off

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard starts and runs, normal performance while running	Key switch or wire harness ground	Check key switch and ground to key switch refer to System Analysis and Electrical and Ignition
	Stop circuit wiring	Check EMM LED indicators. Check wire harness (black/yellow) and key/stop switches
	EMM Failure	Check EMM LED indicators and eliminate stop circuit as possible cause. Stop wire (black/yellow) has 4.0 VDC from EMM with key on or outboard running.

Outboard Starts and Stalls

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Outboard may not run for more than a few seconds	Faulty wiring, connections, or grounds	Check all grounds, connections, and wiring
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Low or no alternator output (55 V)	Check voltage on 55 V circuits, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit, refer to System Analysis and Electrical and Ignition
	Contaminated or poor fuel quality	Check or replace fuel supply
	Low fuel pressure	Check pressure, refer to Fuel System
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Fuel supply restricted	Check anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Injector electrical circuit or control function	Check voltage at injectors, refer to System Analysis
	Restricted or leaking fuel injector(s)	Check injectors, refer to Fuel System
	EMM program, timing, or operation	Check EMM program and timing; check injector coefficients; and monitor injector control wires and ignition primary outputs
	Weak or erratic ignition output	Check ignition, refer to System Analysis and Electrical and Ignition
	Internal powerhead damage	Check and repair as needed

Outboard Starts, Low Maximum RPM

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
SystemCheck light	Outboard in *S.A.F.E.*	Access EMM fault codes and check *SystemCheck* warning
Setup or rigging change	Incorrect propeller	Refer to specifications, check recommended WOT RPM; water test and install correct pitch propeller
	Incorrect outboard mounting height	Refer to installation guidelines
Performance of outboard at lower speeds appears normal	Throttle plate opening	Check throttle plate and WOT opening
	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Contaminated or poor quality fuel	Check or replace fuel supply
	Fuel supply restricted	Check anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Low alternator output (55 V)	Check voltage on 55 V circuits, refer to System Analysis and Electrical and Ignition
	Weak or erratic ignition operation	Check ignition, refer to System Analysis and Electrical and Ignition
	Fuel injector electrical circuit or control function	Check voltage at injectors, refer to System Analysis
	Restricted or leaking fuel injectors	Check injectors, refer to Fuel System
	Low fuel pressure	Check circulation pump operation, refer to Fuel System
	EMM programming, timing, or operation	Check EMM program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Restricted engine exhaust	Check and repair as needed

Excessive Smoking

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
May coincide with increased oil consumption (normal if occurs after winterization)	Contaminated or poor fuel	Check or replace fuel supply
	Excessive fuel or oil consumption	Check fuel system for fuel supply air leaks or leaking fuel injectors
	Outboard in break-in mode	Use diagnostic program to confirm
	Outboard mounted too low	Check installation height of outboard
	Vapor separator vent	Check vapor separator assembly for proper venting/ float valve operation
	Faulty/leaking fuel injector(s)	Check injectors, refer to Fuel System
	Damaged fuel lift pump	Check for internal leaks

Outboard Surges, Runs Rough

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
1200 RPM and above	*S.A.F.E.*	Access EMM fault codes
May be erratic or inconsistent	Incorrect, fouled, or worn spark plugs	Replace spark plugs
	Water in fuel system	Check water separator/fuel filter, sample fuel from fuel return manifold test port
	Contaminated or poor fuel quality	Check and replace fuel supply
	Low or erratic fuel pressure	Check pressure, refer to Fuel System
	Air in fuel system	Check for air in fuel supply manifold, refer to Fuel System (vapor separator venting and fuel supply)
	Fuel supply restricted	Check anti-siphon valve, and fuel pick-up, check for fuel system air leaks
	Restricted or leaking fuel injector(s)	Check injectors, refer to Fuel System
	Faulty wiring, connections, grounds, or CPS air gap	Check all grounds, connections, and wiring. Check CPS air gap.
	Low alternator output (55 V)	Check voltage on 55 V circuit, refer to System Analysis and Electrical and Ignition
	EMM program, timing, or operation	Check EMM program and timing; check injector coefficients; and monitor injector circuits and ignition primary outputs
	Weak or erratic ignition operation	Check ignition, refer to System Analysis and Electrical and Ignition
	Capacitor or 55 V circuit wiring	Check capacitor and 55 V circuit (white/red), refer to System Analysis and Electrical and Ignition
	Restricted engine exhaust	Check and repair as needed
	Propping	Change propeller type or size as needed
	Internal powerhead damage	Check and repair as needed

OBSERVATION	POSSIBLE CAUSE	PROCEDURE
Audible noise	Damaged gearcase	Inspect gearcase and lubricate

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